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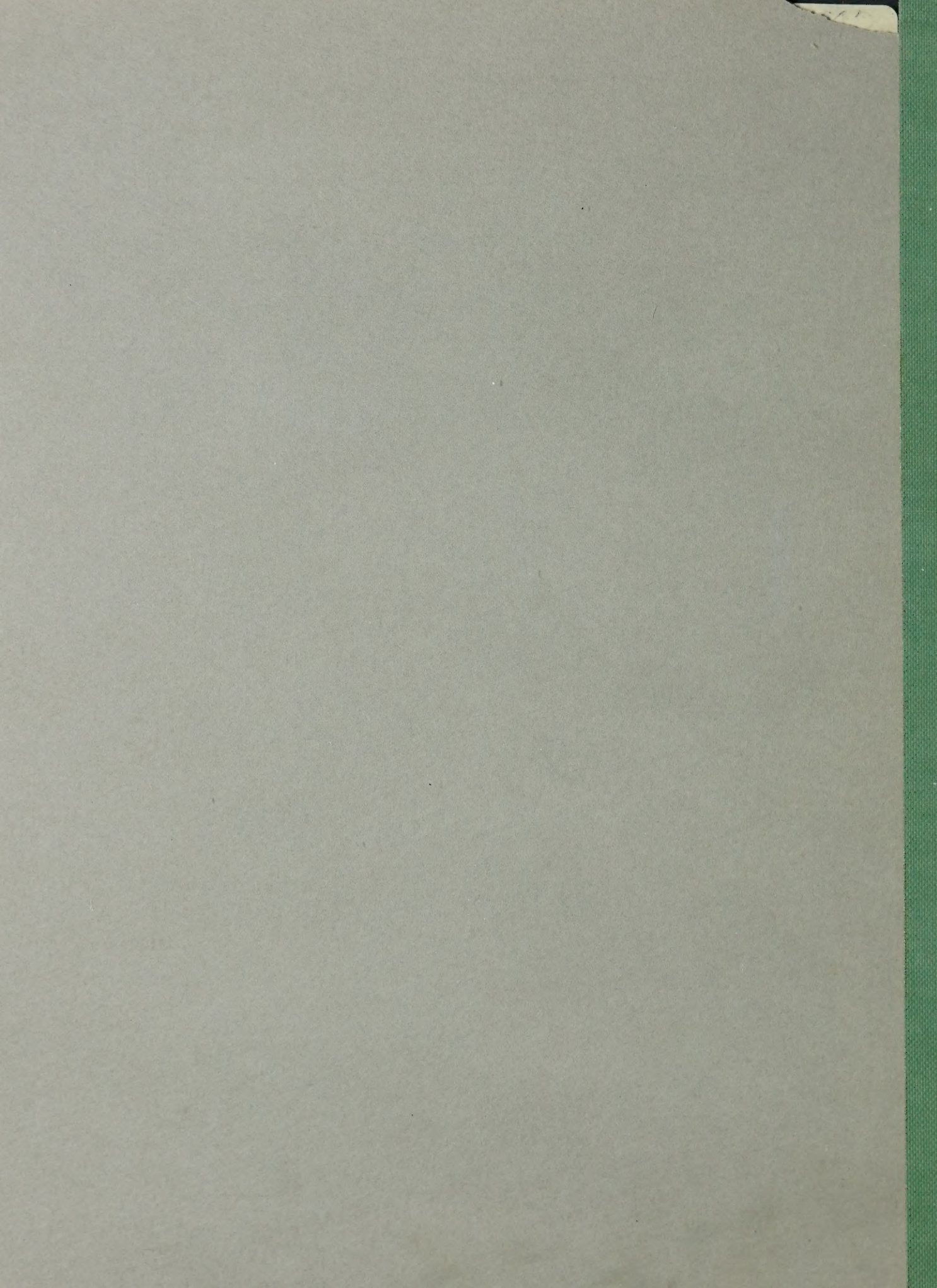
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1945/46

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PUBLIC INVESTMENT

**REFERENCE BOOK
FOR
DOMINION-PROVINCIAL CONFERENCE
ON RECONSTRUCTION**

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Canada. Dominion-Provincial Conference
on Reconstruction, 1945/46

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FOREWORD

This reference book is intended to provide a descriptive, factual summary of the division of responsibilities and activities of Dominion and provincial governments in the field of public investment. The material has been divided into two main parts, Natural Resources and Other Public Projects. It has been found more convenient and practical to leave the description of public investment in Agriculture in the reference book of that title rather than to separate it from other aspects of Dominion-provincial activities with respect to Agriculture and include it in the part of this volume dealing with Natural Resources.

The material in this volume has been compiled under the direction of the Committee on Public Investment of which A. A. MacKay was Chairman and M. C. Urquhart, Secretary, by Sub-Committees on Resources Development and Public Projects, reference to each of which is made in the Foreword to the relevant part of the text.

The description of provincial activities has been based on publications of provincial departments and the knowledge of Dominion Officers concerned with similar activities.



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PART I

NATURAL RESOURCES

1. FOREWORD

The following material has been compiled under the direction of the Sub-Committee on Resources Development of which Dr. C. C. Camsell was Chairman and J. D. B. Harrison, Secretary.

The Sub-Committee was requested to describe the existing division of responsibilities and activities between the Dominion and the provinces with respect to the development and administration of natural resources other than agricultural lands and fisheries.

It has been found impractical to discuss the division of work between the Dominion and the provinces entirely on the basis of the individual resources because a great many activities are concerned with the development of several resources. Under these circumstances the following discussion has been sub-divided according to the subjects dealt with by the various divisions of the Department of Mines and Resources.

2. DEVELOPMENT AND ADMINISTRATION

Prior to Confederation the Canadian economy was chiefly based on agriculture, the timber trade, fishing, fur, and shipping. Only a small proportion of the vast area of the Dominion was settled and much of the remainder was virtually unknown. Production of minerals was small and water powers were undeveloped. The necessity for conserving wildlife had scarcely been recognized except by a few of the more far-sighted members of the fur trade.

During the ensuing 78 years the population of Canada has more than trebled and the country has emerged from the pioneer stage to fill an important place in the British Commonwealth and among the nations of the world. The material foundation for this remarkable progress has been the Dominion's rich inheritance of natural resources. To-day, Canada ranks among the chief exporters of the world and her shipments to other countries comprise not only agricultural products and raw materials but also very great quantities of fully manufactured goods. Furthermore, she has become able to supply her own needs for finished goods to a degree and in a variety which might have seemed impossible at the beginning of the present century.

Table 1 shows the net value of production of the primary industries of Canada, and the value of all production including manufacturing for the years 1937 and 1942. This table gives a clear idea of the relative importance of the different primary industries of Canada.

TABLE 1
NET VALUE OF PRODUCTION
Thousands of Dollars

<i>Primary Production</i>	<i>1937</i>	<i>1942</i>
Agriculture	678,953	1,691,540
Forestry	284,504	429,079
Fisheries	34,439	64,822
Trapping	10,477	23,801
Mining	372,796	514,110
Electric Power	140,964	200,345
Total—primary ...	1,522,133	2,923,697
TOTAL, ALL PRODUCTION	2,970,617	6,258,465

The relative significance of products of the different resources in the external trade of the Dominion is illus-

trated by the figures for 1942 shown in Table 2 which appears on the following page.

Most of Canada's highly developed manufacturing industries depend for their raw materials on sources within the Dominion. Fundamentally, the natural resources of the country are just as important now to the whole Canadian economy as they were a century ago. The continued prosperity and growth of the manufacturing industries depends, without qualification, on the continuity of its domestic supplies of raw material. These supplies are large indeed, but they are by no means unlimited. In some cases adequate supplies for the future are not yet in sight and intensive exploration of new areas is urgently necessary; in others, it is known that improvements to present methods of protection and conservation can alone provide the basis for the future expansion of industry which is potentially possible. Thus, the conservation of natural resources and efficient utilization of their products present problems which must be solved if Canada's prosperity is to endure.

DIVISION OF RESPONSIBILITIES

Modern management of natural resources consists of two phases which may be described as administration and investigation, using the latter term to cover the broad field of surveys, research, and experimentation. By the terms of the British North America Act ownership and administration of the natural resources within their boundaries was assigned to the governments of the provinces. The same arrangements have since been made with the five provinces who joined Confederation at later dates, although administration of their natural resources was not transferred to the Prairie Provinces until 1930. All provinces, then, administer their own resources and their governments receive all revenues which arise from them by way of royalties, rentals, dues, or from outright sale. The Dominion retains responsibility for administration of the resources under its direct administrative control, including the Northwest and Yukon Territories, the National Parks, Indian Reserves, and a few other small and scattered areas of minor importance.

In the broad field of investigation, as distinct from administration, the provinces have carried out important activities, many of which have been directly connected with the solution of pressing administrative problems. Varying natural conditions and differences in financial ability have resulted in wide variations, as between provinces, in the kinds and amounts of investigative work carried out. Up to the present time the Dominion has carried out the larger part of the surveying, mapping, research projects, and technological investigations for the promotion of resources development. Some phases of this work have been recognized in practice as exclusive Dominion responsibilities, while in other fields work of the same general classes has been performed by both Dominion and provincial departments of Government. Universities and industries have also made significant contributions in the investigative field.

Although direct revenues from most of the natural resources of Canada accrue to the provinces, the expenditure of Dominion funds for the purpose of improving conservation and wise use is justified by the national

interest. The whole Canadian economy rests on the development of its natural resources. Furthermore, the Dominion Treasury receives large revenues, directly and indirectly, from their exploitation.

DEPARTMENT OF MINES AND RESOURCES

Responsibility for the administration of all resources within the northern territories and other areas under direct Dominion control lies with the Department of Mines and Resources. This Department is also chiefly responsible for the Dominion share of surveying, mapping, and research work concerned with the development of resources throughout Canada, although some other departments contribute certain services. The Department was established by Act of Parliament in 1936 and took over all responsibilities and activities of the former Departments of the Interior, Mines, Indian Affairs, and Immigration and Colonization. It is organized in five branches—Mines and Geology; Lands, Parks and Forests; Surveys and Engineering; Indian Affairs; and Immigration—of which the first four are concerned, in one way or another, with natural resources.

Each branch is made up of a number of bureaux or services which are further sub-divided into divisions. Each administrative unit is concerned with some particular resource or with a particular activity essential to resources development, and this sub-division of the field is shown in succeeding sections of this report.

Although the Dominion is completely responsible for the administration of the areas concerned, descriptions of the activities and responsibilities of the Indian Affairs Branch, and the Bureau of Northwest Territories and Yukon Affairs of the Lands, Parks and Forests Branch, are included in this report in order to show the part played by these administrations with respect to natural resources.

3. MINES AND GEOLOGY

Mining has become one of Canada's most important primary industries, yielding first place only to agriculture in net value of annual production since 1931.

Moreover, Canada has attained a leading position among the world's mineral producers—in 1938, the year preceding the outbreak of the Great War, ranking first in nickel, asbestos, and platinum; second in radium; third in gold, silver, copper, and zinc; and fourth in lead. These mineral products were sold mainly for export, and have thus assisted very materially in maintaining Canada's foreign credits. Canada's large and increasing gold production played a particularly important part in that respect during the depression and early war years. This large-scale development of its mineral resources, mostly within the present century and especially since the end of the 1914-18 War, has enabled Canada to make a major contribution to the huge metal and mineral requirements of the Allied war effort.

The Canadian mining and metallurgical industry provides many jobs for Canadians, both directly and indirectly; large home markets for the Canadian farmer, lumberman, and manufacturer; and very substantial traffic for the railways. It has been responsible for and supported in no small degree the development of water powers resources, and has pioneered the development of Canada's air transportation. And, not least, it has demonstrated conclusively the wealth-producing potentialities of the 85 per cent of Canada's non-arable and remote areas, most of which were formerly regarded as little more than a national liability.

CANADA'S MINING AND METALLURGICAL INDUSTRY

	1937	1943
	\$ 000's	\$ 000's
Net value of mineral production.....	372,796	475,529
Value of exports of primary mineral products, excluding gold.....	135,252	167,178
Value of gold produced.....	143,327	140,575
Wages and salaries paid*.....	114,292	207,576
Dividends paid by Canadian mining companies	106,794	94,757

* Employees numbered 105,414 in 1937 and 112,140 in 1938.

TABLE 2
EXPORTS, IMPORTS AND BALANCE OF TRADE BY MAIN GROUPS OF COMMODITIES, 1942 (excluding gold)
Thousands of Dollars

Main Groups	EXPORTS					IMPORTS	Balance of Trade
	Domestic			Foreign	Total		
	Raw Materials	Partly Manu- factured	Manu- factured				
Agricultural and Vegetable Products.....	161,590	803	95,385	1,093	258,871	147,740	+111,131
Animals and Animal Products.....	67,225	6,401	183,099	923	257,648	34,931	+222,717
Fibres, Textiles and Textile Products.....	108	3,447	25,377	1,452	30,384	189,066	-158,682
Wood, Wood Products and Paper.....	27,378	187,494	174,933	384	390,189	38,177	+352,012
Iron and Its Products.....	1,056	21,250	444,816	5,708	472,830	377,765	+ 95,065
Non-Ferrous Metals and Products.....	27,845	237,844	43,214	1,426	310,329	82,416	+227,913
Non-Metallic Minerals and Products.....	14,339	30,320	11,921	1,575	58,155	221,353	-163,198
Chemicals and Allied Products.....			77,333	875	78,208	66,824	+ 11,384
Miscellaneous Commodities.....			520,595	8,257	528,852	485,970	+ 42,882
Totals.....	299,541	487,559	1,576,673	21,693	2,385,466	1,644,242	+741,224

Division of Responsibilities

The administration of mineral resources has always been a responsibility of government, which also administers legislation designed to provide for employment of qualified miners, safety, adequate ventilation, health, etc., in mining operations.

Workable deposits of minerals of economic interest are so sparsely distributed that effective prospecting for their discovery can be carried on only after the relatively small areas of rock formations known to be favourable for their occurrence have been outlined on geological maps and described in geological reports, following geological surveys and investigation, so that the search may be concentrated in such areas. Mineral-bearing rocks vary so much in complexity and mineral content that, in general, the commercial possibilities for developing a mineral prospect into a mine can be appraised only after the technological researcher working in adequately equipped laboratories has made the investigations and tests necessary to develop commercial methods of treatment for maximum economic recovery of the minerals contained and for their reduction or conversion into marketable mine products. The provision of both of these classes of investigatory services, which are indispensable to the effective exploration and development of mineral resources, has, within little more than a century, come to be recognized as a responsibility of government, as both are beyond the resources of small private enterprise.

Under Section 109 of the B.N.A. Act, 1867, ownership of all lands, mines, minerals and royalties was retained by the provinces. The administration of the mineral resources of a province is therefore the sole responsibility of the provincial government, which also administers provincial legislation pertaining to all phases of mine development and operation. The Dominion similarly administers the mineral resources of the Territories of the Dominion, and administered the mineral resources of the Prairie Provinces under special arrangements until 1930.

Twenty-six years prior to Confederation the Province of Canada (now Ontario and Quebec) provided for the institution and maintenance of a Geological Survey, whose functions were defined in general terms in legislation up to Confederation as the making of an accurate and complete Geological Survey of the Province; the furnishing of a full and scientific description of its rocks, soils and minerals, to be accompanied with proper maps, diagrams and drawings, together with a collection of specimens to illustrate the same; the establishment and maintenance of a Geological Museum; and the establishment of permanent reference marks as an accurate basis for locating topographical and geological features.

Although the Geological Survey was not enumerated in either Section 92 or Section 91 of the B.N.A. Act, 1867, as one of the classes of subjects within the legislative authority respectively of the provinces or of the Dominion, the first Parliament of Canada, under Chap. 67, 31st Victoria, Part 2, 1868, provided as from July 1, 1867, for the continuation and maintenance of the Geological Survey; for the taking over of the existing staff, records, and duties; and for extending its field of operations to the whole of the Dominion. In the Manitoba Act, 1870 (confirmed by the B.N.A. Act, 1871), creating that Province, and in the Imperial Orders in

Council of 1871 and 1873, whereby, under the authority of Section 146, B.N.A. Act, 1867, British Columbia and Prince Edward Island were admitted into the Union, the Geological Survey is enumerated as one of the services the charges for which were to be assumed and defrayed by the Dominion. It has therefore been generally regarded that the Dominion has special statutory responsibilities to those three Provinces in respect of the Geological Survey. Section 146, however, stipulates that the terms and conditions under which the colonies or provinces named therein were to be entered into the Union by Imperial Order in Council were in each case to be "subject to the provisions of this Act."

The Dominion's early responsibilities and activities pertaining to the mineral resources of the several provinces and their development were therefore confined to the investigatory work carried on by the Geological Survey of Canada, including the making of geological surveys, maps, and reports; the making of the base topographical maps required for such purposes; and the maintenance of the Geological Museum. It should be noted that the geologists during their field investigations also collected a wide diversity of information on geography, climate, flora and fauna, native inhabitants, forests, water powers, etc., and thus performed a highly essential service in respect of the vast new and little known territories added to the Dominion following Confederation. Such activities were confirmed in later legislation pertaining to the Geological Survey as added responsibilities, and led to the development of the Geological Survey into the Geological and Natural History Survey with its related museum activities.

At Confederation mining was confined mainly to Nova Scotia, to the areas near the St. Lawrence and the Great Lakes, and to placer gold operations in British Columbia, and, although no reliable figures were being collected for record, it was known that production was small. By the early 1880's mining was attracting greater interest, and representations were being made by the mining industry for broadening of the Dominion's activities as then carried on to assist in the discovery of mineral deposits. A Select Committee of the House of Commons which investigated the operations of the Geological Survey in 1884 commented upon the need for greater attention to the growing mineral industry and for the collection of mining statistics. This work was accordingly commenced by the Geological Survey in 1886, and in 1890, by Chap. 53, Victoria 53, the Geological Survey was given additional investigatory duties pertaining to mines and mineral resources, including the making of chemical investigations; the collection and publication of full statistics of the mineral production and of the mining and metallurgical industries of Canada; and the collection and preservation of all available records of the artesian and other wells and of mines and mining works in Canada. It was also required to study the facts relating to water supply, both for irrigation and for domestic purposes.

The continued growing appreciation by Parliament, upon representations by the mining industry, that it was essential for the Dominion to accept larger responsibilities for the carrying on of mineral technological investigations and for the provision of laboratory facilities for that purpose in order to encourage mining development led to the reconstruction of the Department of the Geological Survey in 1907. The Mines

and Geology Act, Chap. 29, 6-7 Edward VII (Chap. 83, R.S.C. 1927), authorized the formation of the Department of Mines, comprising the Museum and two main Branches, namely, The Geological Survey, which was to retain all of its former responsibilities pertaining to geological and allied activities, and The Mines Branch, which was to undertake mineral technological and economic investigatory activities, and to take over the activities of that nature that had been carried on by the Geological Survey. These Dominion responsibilities and activities pertaining to mining in Canada are essentially those of the present Mines and Geology Branch, the successor of the Department of Mines when that and other Departments were consolidated in 1936 by Chap. 33, 1 Edward VIII, to form The Department of Mines and Resources.

A few changes have, however, been made since 1907. The collection and publication of mineral statistics was transferred to the Dominion Bureau of Statistics in 1921 when the responsibility for all statistics was consolidated in that Bureau. The administration of The Explosives Act, 1914, for the regulation of the manufacture, testing, storage, and importation of explosives was undertaken in 1920 when the Act became law. The Dominion Fuel Board was formed in 1922, to study Canada's fuel problem, which was then particularly acute, and its small staff was attached to the Department of Mines. Later this Board was charged with the administration of the Domestic Fuel Act and of the subventions granted by Parliament to assist the movement of Canadian coal into Central Canada and of British Columbia coal into certain specified external markets. In 1941 the powers, duties, and functions of the Board (and its staff) were transferred outside the jurisdiction of the Mines and Geology Branch, and are now vested in the Coal Controller, Department of Munitions and Supply. The Department of Mines also undertook in 1936 the administration of special assistance to the improvement of transportation facilities into mining areas under co-operative arrangements with the provinces; and during the war has likewise administered the expenditure of funds from the War Appropriation upon special projects connected with the development of supplies of strategic minerals and oil.

Dominion Activities

The present Dominion responsibilities and activities pertaining to provincial mineral resources as undertaken by the Mines and Geology Branch, mainly through the Bureau of Geology and Topography, The National Museum of Canada, and the Bureau of Mines, are predominantly investigatory in character, covering the field of mineral technology and economics as well as that of mineral resources exploration. The first ore-dressing laboratories were established in 1910, and have been expanded as required by the demands for their services by the Canadian mining industry during an era of extraordinary growth until the present ore-dressing and industrial minerals laboratories are recognized as among the most completely equipped in the world. Calls have been made upon them to carry on investigatory work for the development of processes for the treatment of mineral-bearing material from practically every sizable deposit found in Canada, and research work has been done at one time or another on the ore of almost every operating metal mine in the Dominion and on a varied lot of industrial minerals. Investigations

are carried on for developing efficient methods of extracting metals from their ores, and—maintaining the continuity of research—for determining the physical properties of the metals and for developing methods of treatment for making these metals more useful in industry. Although there is room for improvement in the equipment of the extractive metallurgy laboratories, the physical metallurgy laboratories, as enlarged for war work, will, with the completion of the new metals forming laboratory now under construction, be the most completely equipped in the world.

The fuels laboratories have also a long record, from 1910, of invaluable investigations designed to assist the development and use of Canada's resources of solid, liquid and gaseous fuels, and plans are made for expansion for the purpose of making larger scale hydrogenation and other investigations on the solid and liquid fuels. In addition, all phases of economics pertaining to Canada's mineral resources have been under long and continuous investigation, and a wealth of data on all subjects related to these resources and their economic exploitation and on the Canadian mining and allied industries has been accumulated.

The Dominion therefore now maintains completely integrated investigatory services and facilities designed specially to assist in the discovery and development of mineral deposits.

These and the other Dominion services or activities pertaining to mining in the provinces are as follows:—

- | | |
|------------------------------------------------------------------------------------------------------|---------------------|
| 1. Geological Surveys | } Bureau of Geology |
| 2. Topographical Mapping | |
| 3. National Museum of Canada. | |
| 4. Research and Technological Investigation in Ore Dressing and Metallurgy, Extractive and Physical. | } Bureau of Mines |
| 5. Research and Technological Investigation in Industrial Minerals. | |
| 6. Research and Technological Investigation in Fuels. | |
| 7. Mineral Economics Investigation and Information. | |
| 8. Administration of The Explosives Act. | |
| 9. Special Projects of National Interest. | |
| 10. Dominion Fuel Board—Assistance to Marketing Canadian Coal. | |

Each of these services or activities is described hereinafter.

Provincial Activities

All of the provinces except Prince Edward Island maintain services for the administration of their mineral resources and mining legislation, and for collecting and publishing mineral and mining statistics, and authentic information on mining operations and development. They provide the services required in each case to promote the development of mineral resources, including improvement of roads to mining areas, mineral identification service, limited free assays to prospectors, etc. The provision of services similar to those of the Dominion as described in the foregoing represents a relatively small portion of their total expenditures pertaining to mining, even in Ontario and Quebec which undertake and carry on geological investigatory work. In the brief supplementary statements relating to the several Dominion services listed in the preceding section, refer-

ence is made, where information has been readily available, to activities of a similar nature carried on by the provinces.

1. GEOLOGICAL SURVEYS

Dominion Activities

The Geological Survey of Canada, in the year of its creation, 1842, had two geologists. The number tardily rose to fifty in 1914, but subsequently fluctuated downward and in 1943 was forty-two, which comprised geologists engaged temporarily as well as those of the permanent staff.

The Geological Survey is at present divided into four sections: Geological, Palaeontological, Mineralogical, and Water Supply and Borings. The Geological section comprises the bulk of the field staff, whose duty it is to map and report on the various areas in Canada selected for study from year to year. The Palaeontological section reports on fossil collections made by the geologists of the staff as well as collections from other geologists working in Canada. It also makes special field studies of type, fossiliferous rock sections for correlation purposes, particularly in oil, gas, and coal fields. In addition, the section prepares and maintains large collections of type fossils for reference purposes. The Mineralogical section identifies mineral specimens submitted by the staff geologists; reports on many samples sent in by prospectors and others from all parts of Canada; and maintains a standard reference set of all known minerals. It also makes field collections of the common varieties of Canadian minerals and rocks, and prepares this material for distribution as collections of various kinds for prospectors and Canadian educational institutions. The Water Supply and Borings section maintains records of wells drilled for water, oil, and gas; prepares logs of wells for which drill core or cuttings are provided, or logs these wells in the field; and compiles available information on the coal deposits of Canada.

The undertaking of new projects in any part of Canada by the federal survey follows a study of requests made by provincial departments, federal departments, mining companies, scientific organizations, Boards of Trade, and other organizations and individuals. Ordinarily those projects are undertaken that (1) can be carried out by the staff available, (2) have a high request priority, and (3) fit into a moderately long-range plan of geological mapping.

In recent years field parties have been distributed as follows:—

<i>Region</i>	<i>No. of parties</i>
Yukon	1-2
Northwest Territories	2-4
British Columbia	4-9
Alberta	2-6
Saskatchewan	1-4
Manitoba	1-5
Ontario	2-4
Quebec	4-8
New Brunswick	1-3
Nova Scotia	1-3
Prince Edward Island	Nil

The work done by the field parties in areas of known or potential mineral value consisted of geological reconnaissance; geological mapping on scales of 1 inch to 1 mile and 1 inch to 4 miles; and detailed geological

study and mapping. To some extent, in various parts of Canada, sands, gravels and clays were studied and mapped; data secured on underground water; and gravimetric, magnetometric, and seismic surveys made to ascertain structure and rock type concealed by overburden or covered by younger strata.

In British Columbia, a branch office is maintained at Vancouver, the geologist in charge of which undertakes special field assignments, keeps in touch with the mineral industry of the province, maintains close liaison with the provincial Department of Mines, and distributes reports and maps.

The present types of reports issued by the Geological Survey, comprise Memoirs, Bulletins, Papers, and reports of the Economic Geology Series. Memoirs are fairly complete descriptive accounts of the geology of particular areas, and are accompanied as a rule by geological maps. Bulletins deal with problems rather than areas. Papers, issued usually in mimeographed form as soon as possible after the close of the field season, treat separately of each area and summarize the information acquired. Economic Geology Series reports deal in a comprehensive way with mineral deposits of a particular type, e.g., "Gold Occurrences of Canada."

Coloured geological maps are issued on various scales, from 1 inch to a few hundred feet to 1 inch to 8 or more miles. The common, standard scales are 1 inch to 1 mile, and 1 inch to 4 miles, the former covering 15-minute and the latter 1-degree quadrangles. Uncoloured maps, on which the geology is shown in pattern, are issued shortly after the field season ends of those areas where the search for metals or oil and gas is active.

Provincial Activities

Departments of Mines were created in Nova Scotia and British Columbia in the early seventies, and in Ontario and Quebec in the early nineties. New Brunswick carried on work relating to mineral resources under the Crown Land Department until 1924 when the Department of Lands and Mines was formed. The Mines Branch of Alberta was formed in 1918, the Department of Mines and Natural Resources, Manitoba, in 1928, and the Department of Natural Resources of Saskatchewan in 1930.

Ontario's Department was essentially geological from the beginning. Quebec added a Geological Division to its Department in 1927. British Columbia began geological study and mapping about 1937. Alberta has carried on geological study and mapping through the agency of its Research Council. The other provinces have not created geological organizations but all except Prince Edward Island have undertaken various geological projects.

The provinces presumably undertook geological surveys because:—

1. It was desirable for administrative purposes to have first-hand information on the facts and possibilities of their mineral resources.
2. The quantity of work done by the Dominion Geological Survey was inadequate for their needs.

The geological work done by the provinces is essentially of the same type as that carried on by the Geological section of the Dominion Geological Survey. The

Ontario Department of Mines does practically all the geological work in that province; this year it began a survey of its Pleistocene geology and underground water supply. British Columbia, Quebec and Alberta engage in geological work of a nature similar to that done in those provinces by the Dominion Government. The provinces do not, however, maintain on their staffs experts in all phases of geology. The geological study of the oil and gas fields of Ontario, for example, and the detailed study and appraisal of British Columbia's coal areas on Vancouver Island are being done by the Dominion at provincial request even though each of these provinces has a strong geological staff.

The following table shows expenditures on Geological surveys by the Dominion Geological Survey and by the provinces. The figures given for the provinces were not obtained from the various provinces but were estimated from Public Accounts and may be inaccurate. It should also be noted that they represent only a small fraction of the money spent by the provinces in connection with mineral resources, being estimates of the costs of geological work only.

	1938	1943
Dominion Geological Survey.	\$425,000	\$438,000
Provincial Organizations.....	\$180,000 (est.)	\$190,000 (est.)

TOPOGRAPHICAL SURVEYS

Dominion Activities

Base topographical maps accurately representing all significant natural and artificial features are fundamental to the study and economic development of mineral, forest, agriculture, water power and other resources.

They are essential to the geologist in both field and office, and the making of topographical maps in Canada for his use commenced with the beginning of the Geological Survey in 1842. Directly or indirectly, topographical mapping has been referred to in all legislation defining the duties of the Geological Survey. The Dominion's statutory responsibilities as regards topographical mapping for that purpose are, therefore, the same as for the Geological Survey.

For about forty years after Confederation most of the work of the Survey was exploratory or reconnaissance in character. The early geologist was his own topographer, observing and recording the topography he needed for mapping his geological explorations. Later, a topographer was attached to each geological party. With the commencement of the systematic geological mapping of Canada early in this century, it was recognized that efficient employment of geologists demanded that topographical mapping precede geological investigation. A separate topographical division was accordingly formed and the present practice of preparing base topographical maps prior to geological investigation was initiated. In 1936, with the consolidation of Departments to form the Department of Mines and Resources, the Air and Ground Mapping Sections of the Topographical and Air Survey Bureau of the Department of the Interior, which had pioneered in Canada in the development of practical methods of plotting topographical maps from air photographs, became an integral part of the Topographical Survey of the Mines and Geology Branch.

With the development of technique, instruments and mechanical aids to plotting maps from air photographs, topographical mapping practice has so changed that it is now considered essential to have photographs of an area which is to be mapped. They are, at present, being provided by the R.C.A.F. and by commercial companies.

The Topographical Survey of the Mines and Geology Branch has the responsibility of providing base topographical maps not only for the Geological Survey but for other departments requiring such maps. Details of scale and priority of areas to be mapped are determined after consultation with the several Departmental Branches concerned. It is necessary that their needs be anticipated so that the air photographs may be provided before the ground control is undertaken.

Several different methods of ground control are employed depending on the scale of map required and the type of country to be mapped: precise astronomical observations, or triangulation and ground photography, or accurate traverses tied to triangulation stations or other fixed points. The control points located in the field must be identified and marked on the air photographs. Developments in both field and office methods are still taking place. Trimetrogon air photography commenced in Canada by the U.S.A.A.F. during the war is now being used in conjunction with ground photography and with astronomical observations to produce four-mile maps.

The plotting of the detailed information from the air photographs once the control is completed requires personnel especially trained in the use and operation of the many different types of equipment designed to facilitate the work and improve the quality of the resulting maps. Some of this equipment is costly and requires a large volume of work to justify the expenditure.

To a very large extent both the federal and provincial governments accept mapping as a responsibility of the Dominion Government. The Topographical Survey operates in all of the nine provinces and in the Yukon and Northwest Territories. Its work in wartime has been confined almost entirely to areas of special interest in respect of strategic minerals and potential oil resources.

During the present season the Topographical Survey has in the field fifteen parties: two in the Yukon and northern British Columbia, four in Alberta, one in the Northwest Territories, one in Manitoba, one in Quebec, four in New Brunswick, and two in Nova Scotia. A staff of thirty is at present engaged in the office in plotting and supervision. This does not include the staff engaged in the reproduction of the maps. Plans have been made and equipment is being obtained to employ fifty to fifty-five field parties with the necessary office staff as soon as men become available from the armed forces.

Provincial Activities

Only one province, British Columbia, has established a topographical section. A small amount of topographical mapping has been done by the provinces of Ontario and Quebec, mostly in connection with their Geological Surveys. Ontario has an aerial surveys section which provides air photographs and map information to the provincial departments and private companies on a repayment basis. With these exceptions,

the provinces rely entirely on the Dominion Government for the provision of topographical maps. Since 1941 the province of Nova Scotia has contributed approximately one-half the cost of the field work carried out by the Topographical Survey in that province. This was done with the hope of speeding up production of base maps urgently required for the development of natural resources.

Expenditure

In 1937 considerably over 90 per cent of the area mapped in Canada was the work of the Dominion Government. The same holds true for 1943. It is not possible to arrive at the exact total of the expenditure by the provinces on mapping but it will roughly bear the same ratio to the Dominion expenditure as the respective areas mapped bear to one another. The expenditure on topographical mapping by the Bureau of Geology and Topography was \$305,000 in 1938-39 and \$287,000 in 1943-44.

NATIONAL MUSEUM

The activities of the Museum are the logical outgrowth of the scientific endeavours of the early staff of the Geological Survey of Canada which came into existence in 1842. Investigations in natural history, as distinguished from geology, had become so extensive and important by 1877 that Parliament recognized the situation by the passing of an Act creating a "Geological and Natural History Survey of Canada". Thereafter Museum activities continued to expand with the result that by 1911 there were separate units for anthropology and biology in addition to those for geology, mineralogy and palaeontology. At present the National Museum of Canada (so designated by the Governor in Council in 1927) embodies mammalogy, ornithology, botany (National Herbarium of Canada), archaeology, ethnology, geology, palaeontology, mineralogy and geography.

The research, investigative, and exhibition activities of the National Museum are systematically directed to problems of national interest and importance. In addition to the National Museum there are in Canada approximately 175 museums of varying size devoted to one or more branches of natural history: these include museums maintained or supported by provincial governments as well as others of lesser importance.

Dominion Activities

The National Museum is concerned with the investigation and study of the natural history, geology, mineralogy, palaeontology and geography of Canada from the national viewpoint. Phases of its work relating to geology, mineralogy and palaeontology are carried on by the Geological Survey and are part of the nation-wide activities of that organization. Similarly the studies in the geographical characteristics of Canada are developed by the Topographical Survey. In its other activities, the National Museum maintains its own staff of scientists organized in two Divisions, the Division of Anthropology and the Division of Biology.

The Division of Anthropology includes ethnology and archaeology, and is devoted to the study of the aborigines of Canada and to the handicrafts and folklore of the various races that make up the Canadian population. The practical application of the work of this Division

to Canadian resources relates largely to the understanding and care of the Indians and Eskimos as wards of the nation.

The Division of Biology is made up of sections relating to the mammals of Canada, the birds of Canada and the wild plants of Canada. Based on the scientific studies and the field investigations of its specialists, reports and data are prepared on the relation of the mammals, the birds, and wild plants of Canada, to our wildlife conservation problems, to our agricultural and forestry development and to many problems relating to food supply.

As the basis of its activities the National Museum maintains permanent and safe repositories for the type and other representative specimens of these sections of its work. Its study collection of mammals numbers some 18,000 specimens, its bird collections about 30,000 specimens and its wild-plant collections about 170,000 sheets of specimens; and it has also collections of comparable size and importance related to its other fields of activity.

Provincial Activities

The Dominion responsibilities and activities devolving on the National Museum are outlined above. Some of the provinces carry on Museum work in the same and related scientific fields: but the National Museum has no authoritative information concerning their respective responsibilities.

Expenditures

The expenditure on activities of the National Museum has averaged about \$75,000 annually in the past ten years.

The only known survey of financial support for museums in Canada was made by the Dominion Bureau of Statistics. Their report of 1938 in this connection may be quoted as follows:—

"Expenditure on the museums with permanent staffs (including archives and art galleries as well as museums in the narrower sense) seems to have been somewhere between \$800,000 and \$900,000 in the year preceding their report.....

..... Roughly one-half of the total seems to be provided by the Dominion Government, one-quarter by the Ontario Government, one-tenth by the other eight provinces combined, one-tenth by associations or endowments, and smaller amounts by cities, non-provincial universities and commercial establishments."

ORES AND METALS

The establishment of Ore Dressing and Metallurgical laboratories in the then Mines Branch, now the Bureau of Mines, was commenced in 1910 to meet the mineral technological research requirements of the growing mining industry. From that year these laboratories have been gradually enlarged until today they are quite as extensive in equipment and facilities as may be found anywhere in the world, and are functioning and giving the most modern service to all parts of the Dominion in extensive research on ores and metals, with a view toward developing new resources, improving production methods and materials, and the development of new techniques.

The activities of the laboratories serve the following broad purposes:—

- (1) To assist new mining ventures by determining the most effective method of recovering metal values that may be contained in their ores,
- (2) To assist mining operators in solving problems in current milling practice,
- (3) To develop new procedures or processes to further the use of the mineral resources of the country,
- (4) To aid in the growth of the metal industries through the development of new alloys, new manufacturing techniques, and new applications,
- (5) To assist in improving present practices in metal fabrication industries, and
- (6) To aid the consumer in making more effective use of metallic products.

This work is divided into two main sections, as carried on in

- (a) The Ore Dressing and Extractive Metallurgy Laboratories,
- (b) The Physical Metallurgy Research Laboratories.

A brief description of the facilities and functions of these laboratories follows, with a similarly brief description of the known activities of a like nature maintained under the guidance and direction of the various provincial governments.

Ore Dressing and Extractive Metallurgy

The total investment in buildings and equipment in this section is well over \$500,000.

The equipment available in these laboratories is as complete and modern as it is possible to make it, and comprises, for ore investigative work, not only the usual small scale laboratory type of test machines, but also large pilot plant scale equipment capable of performing investigations on the ton basis. The laboratory is so designed that any, or all, combinations of treatment methods employed in extractive metallurgy can be performed on a given ore. This is particularly advantageous in investigations concerning complex or refractory type ores, of which an increasing proportion is now being encountered.

Ores have been received for investigation from all parts of the Dominion, and include those of almost every type of commercially usable metal.

Samples of ores from a few hundred pounds to 50 tons or more are accepted for investigative work, and a capable staff of engineers undertake in each case the development of the most economic method of treatment and preparation of a report detailing the results that may be anticipated and the method, or flow sheet, by which such a result may be attained. Such samples may be submitted by the prospector; the prospecting or mining syndicate who performs the exploratory work on a new ore discovery; the mining company who develops the property to the stage where a milling plant or smelter is erected; the consulting engineer and the contractor who design and erect the plant; and the operating company which may be experiencing difficulties in its metallurgical practice, or seeking to improve its method of treatment to increase recoveries or reduce costs.

The facilities include a milling or dressing treatment investigation laboratory, housing the various types of equipment for extracting the metallic values from the

ores; a pyrometallurgical laboratory for application, where necessary, of methods employing sintering, roasting and other furnace methods; and the chemical and mineralogical laboratories, where the ores are examined prior to any treatment work.

The facilities of the laboratories have, at various times, been utilized by several mining companies in working out some particular process, using their own staffs with the guidance and co-operation of the staff of the Laboratories.

Physical Metallurgy Research

The Physical Metallurgy laboratories, as at the end of the year 1944, represent an investment of about \$500,000 in buildings and equipment. An extension, now under construction, will increase the investment by some \$750,000 making a total investment of \$1,250,000.

Physical Metallurgy was a comparatively new science in 1907 when the former Mines Branch was formed, and much of the early work carried out was, of necessity, of a pioneering nature. It comprised, in part, investigations of methods for the electrical smelting of Canadian iron ores; development of procedures for smelting zinc ores; the determination of the physical properties of the metal cobalt, etc. The erection of a pyrometallurgical laboratory in 1928 marked the beginning of the present physical metallurgy laboratories. This laboratory was equipped with melting furnaces, mainly electric, of high frequency and arc types, electric heat treating furnaces, and the standard laboratory physical testing and metallographic equipment, on both laboratory and semi-commercial scales. The work was primarily concerned with iron and steel production, and physical properties. In 1930 these facilities were further extended to meet the growing demands of the metal industry. Investigations related to the utilization of Canadian iron ores for steel making, and to new techniques and processes, such as production of sponge iron and alloy steels. A competent staff was in charge of the work and, at the commencement of the war, the laboratories were in a position to render valuable and important service to the production of war armaments.

In due course the laboratories were called upon to handle such a large volume of war work in physical metallurgy that additional facilities were needed and, on the recommendation of a committee representing the war departments, new metallurgical laboratories were erected and equipped.

These laboratories constitute the official Government research organization in the field of metallurgy. The National Research Council has not entered this field, but close co-operation is maintained between the two organizations. The physical metallurgy research laboratories are, in reality, a collection of many laboratories, each equipped for some special operation or purpose. An industrial laboratory is equipped to melt metals and produce ingots or castings. Forging, rolling, extruding, die casting, welding, and heat treatment can be carried out in the same manner as prevails in industry. In the mechanical laboratory, metals are subjected to vibration, torsion, impact, compression, and tension, and their reaction to all kinds of mechanical strain is observed. In the physics laboratory, the electrical and thermal properties of metals are measured, and also the reaction of steels to treatment. In other laboratories every obtainable instrument is at hand to probe into the properties of metals. The laboratories are being continually equipped

with the most modern collection of metallurgical tools and instruments available, so that it will be possible not only to examine any metal for its properties, but to produce any kind of metal or alloy in cast, forged, rolled or extruded condition. In the Corrosion Section methods of corrosion prevention on any metals can be studied. A section is being set up for studies in powder metallurgy to give assistance in this new field of metallurgical practice.

The latest metallographic and spectrographic equipment is available, and chemical laboratories are fully equipped for any type of analysis.

Machine shops of the Bureau of Mines prepare test specimens and provide requirements in sheet metal work, welding, cabinet making, tool making and instrument making.

Industry is encouraged to make full use of the laboratories and facilities available; and it is expected that, under conditions acceptable to the Bureau, industry will have its own metallurgists work out its own problems in the laboratories under the guidance of the Bureau's metallurgical specialists.

Provincial Activities in Ore Dressing and Metallurgy

Each province is interested in research leading to the development of its resources, and, while research in ore dressing and metallurgy has been left almost entirely with the Dominion Government, the Provinces of British Columbia, Ontario, Quebec, and Nova Scotia, have each established less comprehensive laboratories which have been of valuable assistance to their respective mining industries. The remaining provinces, experiencing less activity in the mining industry, have no special laboratory facilities for such investigations, except as may have been provided through provincial assistance to University laboratories.

The British Columbia War Metals Research Board was established in the early years of the war to supplement part of the work of the Dominion laboratories. Recently (December 31, 1944), the Board ceased to exist, but the work will be carried on by the Metals and Minerals Division of the B.C. Industrial and Scientific Research Council. Although the problems in reduction metallurgy and mineral dressing were limited in extent in the past few years, this laboratory is expected to perform useful services in the postwar years.

Part of the equipment for their laboratories, housed in the Mining Building of the University of B.C., has been provided by the University Department of Mining and Metallurgy; and the War Metals Research Board has contributed some of the larger items. For the year 1944-45 the Board was supported by grants from the Provincial Government of British Columbia, Department of Trade and Industry B.C., B.C. Research Council, and the Dominion Government, the last being from an allocation of the War Appropriation to the Mines and Geology Branch. Information and reports are freely exchanged between the two laboratories.

The Ontario Research Foundation, established in 1928, carries out a limited amount of ore dressing investigation, but conducts a fairly extensive amount of work on physical and other metallurgical problems, mostly of a private and confidential nature, as it works directly with industry. The Foundation was originally endowed by the Ontario Government and interested industries, but has during the war become almost self-sustaining by means of service charges, etc., from in-

dustry. The Ontario Department of Mines provides an assay and mineral identification service to prospectors, free or at nominal cost. It does not, however, provide laboratory facilities for ore dressing or extractive metallurgy.

The Province of Quebec provides a service, through its Department of Mines, to prospectors, by means of well-equipped chemical, assay, spectrographic, and mineralogical laboratories. The province also has supplied certain universities with ore dressing and metallurgical equipment. The Laval University laboratories, for one, have been equipped with a very complete and modern ore dressing and extractive metallurgy laboratory, and can also carry on preliminary examination and standard physical testing of metals. At Val d'Or the province has provided a laboratory in the nature of a Mining School, where men are trained for employment in the mining industry.

The government of Nova Scotia has provided in the Nova Scotia Technical College fairly well equipped laboratories which are serving a useful purpose in the appraisal of mining prospects.

Dominion-Provincial Co-operation

The Dominion Laboratories co-operate in the fullest manner possible with all of the provinces by supplying any information desired, and by furnishing copies of all reports on investigations carried out on materials originating in the respective provinces. Copies of reports on all provincial projects undertaken are also furnished the respective provincial Departments of Mines by these laboratories.

Provincial activities in ore dressing and extractive metallurgy investigation have therefore been confined to preliminary experiment. It would be safe to assume that the Dominion laboratories are responsible for over 90 per cent of the activities in this field; and, also, excluding the Ontario Research Foundation, for about 95 per cent of governmental activities in the field of physical metallurgy research in Canada.

INDUSTRIAL MINERALS

Dominion Activities

Dominion activities in the field of industrial minerals, that is, minerals (including water) and rocks of economic value other than those used as fuels or ores of metals, bear upon their economic characteristics, mining, marketing, and uses, and their beneficiation and processing with a view to their better utilization. Current and continuing work includes the testing of the physical and chemical properties of a number of industrial minerals and their products and the furtherance of investigatory work on preparing and using them. This is carried out in several laboratories well equipped for the purpose and costing collectively \$300,000. Milling laboratories, for example, serve for the preparation of minerals for commercial use, and for tests to determine the most economic methods for the comminution, purification, or other treatment of minerals, rocks, or clays; ceramic laboratories for investigation of the grade of clays, shales, and other minerals which enter into the production of brick, tile, stoneware, refractories, porcelains, glass, and other ceramic products, and of the quality of such products; and Road Materials laboratories for the testing of rock, gravel, and sand to deter-

mine their usefulness for the construction and maintenance of roads. An insight into the significance of such activities is afforded in the following paragraph.

A more or less recent outgrowth of the investigatory work that has been carried out on Canadian limestones continuously since 1925 has been the establishment of the rock-wool industry. There are now six plants in operation in eastern Canada, whose aggregate production in 1944 was valued at \$2,000,000, each of which came into being as a result of the aid it was possible to render through this investigatory work. The similar assistance which is at present being given is likely to result in five more plants manufacturing rock wool. Another outgrowth of the same work has been the discovery of the magnesium mineral brucite in large well-known deposits of limestone in Ontario and Quebec where its presence had not been hitherto suspected. Laboratory research into the properties of these brucitic limestones gave birth to the development of a process, now in commercial operation, for the production of granular magnesia (used for the making of high-grade refractories) and hydrated lime. In the hope of further extending the use of these limestones, research is being pursued to find out how to produce economically from the brucite they contain basic magnesium carbonate, active magnesia, and magnesium sulphate.

Provincial Activities

The facilities the provinces have for engaging in work along similar lines are, for the most part, comparatively small in scope, and unsuited to work on the scale or in the detail that is carried out on industrial minerals by the Dominion.

A number of provincial Highway Departments have laboratories for testing road materials—which it was logical for them to establish during their heavy construction programs—and such work has since been left in their hands. Some provinces, however, have continued to avail themselves of the Dominion services in this connection—which are now largely devoted to meeting the requirements of the Dominion Department of Public Works—by requesting road materials surveys along specified routes, and by submitting samples of rock and gravel for testing.

Saskatchewan is the only province in which extensive work has been done on problems of the ceramic industries. In that province much attention has been given to the testing of the clays found there and to the problems of their utilization through the co-operation of the University of Saskatchewan. In Ontario the distribution and character of the Cretaceous clays occurring in the Moose River basin have been investigated by the Ontario Department of Mines in co-operation with the University of Toronto and the Ontario Research Foundation. The latter institution undertakes ceramic and other investigations for individual industrial clients, to whom alone the results are made available.

FUELS

Dominion Activities

Research and technological activities of the Dominion on fuels comprise (a) investigation of Canadian fuel resources and the methods of developing them, and (b) investigations to determine the characteristics of these resources and ways of processing, utilizing, and

extending the markets for them. For these and related purposes the work in the Fuel Research Laboratories embraces:—

- (1) Analyses, classification, and studies of the characteristics, of coals from different collieries.
- (2) Combustion engineering tests in different types of stoves and boilers; carbonization tests at high, medium, and low temperatures; briquetting tests with and without the use of a binder; and hydrogenation tests on both small and large laboratory scales. The purpose of these tests is to ascertain the amenability of Canadian coals to utilization in the raw state and to different kinds of processing.
- (3) Analyses of natural oil and gas products collected by geologists, process oils and gases produced in laboratory tests, and of mine air from coal and other mines.
- (4) Analyses of coals, peat, oil shales, and bituminous sands in their natural state, and of coals, cokes, and chars after processing by crushing, carbonizing, briquetting, etc.
- (5) Research on methods of analysing solid, liquid, and gaseous fuels, and analysis surveys of coals, coke, crude oils, gasoline, and fuel oils as produced and marketed.

Provincial Activities

Alberta, Nova Scotia, and Ontario have laboratory and staff facilities for testing and research work on fuels; British Columbia only for small-scale analyses and testing of coals.

The work in Alberta is administered by the Research Council of that province which was created in 1921, and is conducted at the University of Alberta. It has included analyses of solid, liquid, and gaseous fuels occurring in the province, research on methods of analyses, tests in household stoves and furnaces, and gas producer, carbonization, hydrogenation, and briquetting tests. Though of fairly wide scope, it has been mostly on a small scale and has varied greatly in amount from year to year according to the funds available. In Nova Scotia, work on coal is conducted in the Nova Scotia Technical College. At present it is largely of a routine analytical nature undertaken in connection with the teaching of science students. Some years ago, however, much work on the testing of coals in furnaces and under boilers was carried out under the auspices of the Nova Scotia Fuel Board. Facilities for work on fuels in Ontario are afforded by the Ontario Research Foundation, which was established in 1928 and endowed by the Ontario Government. But apart from some co-operative investigatory work on peat by the Joint Peat Committee, composed of representatives of the Dominion and provincial governments, and the investigations on Onakawana lignite at the instigation of the Ontario Department of Mines, the work on fuels by the Ontario Research Foundation has been of a limited nature.

There is much interrelation of Dominion and provincial activities as regards fuels since such work as is done by the provinces is largely based on that of the Dominion Fuels Research Laboratories which is applicable to those industries that are of particular interest and value to the respective provinces.

MINERAL ECONOMICS

Dominion Activities

An important phase of activities of the Bureau of Mines is the collection, recording, and analysis of all available information pertaining to the economic development of mineral resources, and more particularly to Canadian mineral deposits and mining operations. This work was first undertaken by the Geological Survey in 1886, and was transferred to the Mines Branch (now the Bureau of Mines) on the formation of the former Department of Mines in 1907. On the basis of the wealth of data, amassed now over many years and continually being added to, on mineral properties and operating mines, mineral exploration and development, processing and production, uses and marketing of minerals and their products, and on mining laws and taxation, the Bureau provides a general mineral information service which is freely used by government departments, mining and allied industries, and others who are interested in mining or its significance in the Canadian economy.

The information is made available through monographs and reports on a specific mineral or group of minerals; lists of mines, milling plants, metallurgical works, etc.; presentation of papers before mining societies; articles for publication in the technical press; public lectures and motion pictures; correspondence; and direct consultation. Reviews, published annually, cover some 70 Canadian minerals, and embody data secured in the field and office on current developments, progress and production, market trends, and other economic aspects. The yearly published Surveys of the deliveries for consumption, by important uses, of petroleum fuels, and of the scale of operation, quality of production, etc., of all coal mines have proved particularly important recently to the Coal Controller, governmental and other fuel-purchasing agencies, and the Royal Commission of 1945 in its investigation of the Canadian coal industry.

The monographs devote special attention to those minerals in which Canada is deficient and to minerals of economic interest; they embody the results of field and laboratory investigations of deposits of such minerals and of the studies made as to the possibilities of their economic exploitation.

Economic studies of the mining industry and matters bearing upon or associated with it have been many and varied. Recently they have been or are concerned with the outlook for mining in various parts of Canada; the influence of mining on employment; peace-time markets for lead and other base metals; aids to prospecting; the significance of the Alaska Highway to the prospector; the abnormal war depletion of Canada's important base-metal deposits; the possibilities of enlarged home markets for Canadian mineral products during the reconstruction period; and Dominion taxation and other legislation affecting mining enterprise. As regards the last item, assistance has been afforded to the Department of National Revenue in matters related to tax exemption of new mining properties; tax deductions as an encouragement to prospecting for base metals, strategic minerals, and petroleum; depletion and depreciation allowances on mining properties; and tax allowances for the drilling of deep-test wells for oil in unproven fields.

Provincial Activities

All the mining provinces perform similar functions to those described above but confined, generally speaking, to their own mining industries. Under authority of provincial Mines Acts pertinent data such as statistics of production, employment, etc., are collected, in which activity there is co-operation with the Dominion Bureau of Statistics.

A number of the provinces have resident mining engineers and mining inspectors who keep in close touch with current mining developments.

ADMINISTRATION OF THE EXPLOSIVES ACT

The Explosives Act, Chap. 62, R.S.C. 1927, was enacted in 1914 for the regulation of the manufacture, testing, storage, and importation of explosives, as a measure designed to reduce the number of accidents in mines and elsewhere involving explosives. Because of the outbreak of the war, the proclamation of the Act was deferred until 1920. In that year, the Explosives Division was formed in what is now the Mines and Geology Branch to carry out the responsibilities of the Minister of Mines for the administration of the Act.

Under the Act, only those explosives, which, after examination, are declared authorized may be manufactured in Canada. Explosives intended for importation must similarly be authorized, and may be imported only by permit issued by the Minister. An explosives laboratory is accordingly maintained by the Division in which the chemical and physical tests and investigations required for administrative purposes are made.

Sites of explosives factories, distribution of buildings, the quantity of explosives in each, the conduct of operations and other factors bearing on the safety of personnel and the public are controlled in licenses issued under authority of the Act. Inspectors of the Division make frequent visits to all explosive factories to ensure that the terms of licence are fully observed.

The establishment of magazines, whether permanent or of a temporary nature such as are used by contractors and logging companies, are subject to licensing and inspection. In addition, large numbers of premises in towns and villages in every province are used for the storage of small quantities of explosives or ammunition; and these are covered by general regulations, in the enforcement of which the R.C.M.P., as Deputy Inspectors of Explosives, render great assistance. The transportation of explosives by road is also subject to regulations made under the Act.

Rapid expansion of the explosives industry followed the outbreak of war in 1939. Many explosives factories, and plants for the manufacture of shells, small arms ammunition, fuses and pyrotechnics were built. All were licensed under the Explosives Act, and their inspection placed a greatly increased measure of responsibility on the inspection staff. This expansion in the making of munitions, and especially of new explosives, brought to the Explosives Laboratory, operated jointly by the National Research Council and the Explosives Division, a great deal of new research work.

Order in Council P.C. 2903, July 4, 1940, issued under the authority of the War Measures Act, enlarged, for the duration of the war, the scope of explosives control to cover possession, use, and sale. In its administration, the Division has received invaluable assistance from the R.C.M.P., the provincial police, and the

municipal Chiefs of Police, without which assistance the users of explosives would have been greatly inconvenienced, and control would have been less effective.

In addition to conducting inquiries into accidents occurring under circumstances directly controlled by the Act, all available information is collected on all accidents with explosives for the purpose of directing attention to good practice designed to avert accidents.

The Act provides for exercise of local control. A province or a municipality may by lawful enactments regulate the storage, handling, sale and transportation of explosives within its boundaries, and the Explosives Act does not relieve any person of obligation to comply.

Officers of the provincial Departments of Mines and Public Works, provincial Police Forces and Workmen's Compensation Boards have worked in close co-operation with the Division's Inspectors in matters related to the storage and handling of explosives. Evidence of the goodwill manifest by the provinces when the Act was being framed and since that time is the fact that during the twenty-five years that the Act has been in force no incident involving Dominion-Provincial jurisdiction has arisen to question the authority of the Act.

SPECIAL PROJECTS OF NATIONAL INTEREST

Special projects of a nature not ordinarily undertaken by the Mines and Geology Branch have been carried out at various periods, sometimes out of large special votes of Parliament, to assist the provinces in development of their mineral resources. The pre-war project of assistance to the provinces in the construction of transportation facilities into mining areas was a program of great national significance that brought about expanded mining operations in Canada. The extensive work financed jointly by the Dominion and Ontario Governments on excavating and processing of peat was a forerunner of the present development of peat resources in several provinces. Exploration of the bituminous sands of northern Alberta, including experimental paving work with the sands and research into uses for the bitumen, was started more than thirty years ago by the Bureau of Mines: during the present war this Alberta resource, which has always held broad national interest, has occasioned considerable expenditures by the Dominion Government to determine its importance in regard to Canada's petroleum supplies. Also as a war project, the oil shales of New Brunswick were investigated by the Dominion in 1942 in co-operation with the province, the latter bearing one-quarter of the cost. Efforts of the Dominion to obtain production of strategic minerals, both by exploratory work and by financing the operation of various mining properties too uneconomic to attract private capital have contributed very largely to increased knowledge of mineral resources.

Transportation into Mining Areas

In 1936 the Dominion Government embarked on a policy, as part of unemployment relief measures, of reimbursing two-thirds of provincial expenditure on approved projects for construction of roads, bridges, wharves, dams, marine railways and other facilities providing access to mines and mining areas. In all, up to March 31, 1940, Dominion financial assistance applied to over 600 projects in the Provinces of Nova Scotia, Quebec, Ontario, Manitoba, Saskatchewan,

Alberta and British Columbia. Actual construction work was carried out by the provinces, which also financed the necessary surveys and plans. Some of the projects were in part financed by the mining companies deriving direct benefits, the company contribution in each case being deducted from gross costs before the Dominion's share in the province's net expenditure was determined. In the fiscal year 1937-38 the Dominion's contributions on projects in the seven provinces amounted to \$1,200,000. Under wartime conditions, Dominion financial assistance to the provinces for transportation facilities was restricted to approved projects involving construction or improvement of roads into strategic mineral properties, and in the fiscal year 1943-44 amounted to \$128,300.

Exploration of Mineral Resources

In 1942 the Dominion resumed active exploration of the bituminous sands of Northern Alberta for the purpose of discovering deposits of such extent and character as to permit of the large-scale production of petroleum. This work is going steadily forward and is yielding information on the deposits that can be of high value for the development of a potentially-important Canadian source of petroleum. The project is being carried on wholly by the Dominion and current expenditure is at the rate of \$200,000 annually. The lack of clues as to where the richest deposits of bituminous sands occur and the lack of economic data on mining and on extraction of bitumen deter private enterprise from engaging in the exploration. Though very limited in extent as yet, core-drilling by the Dominion totalling 16,827 feet up to March 31, 1945, has outlined one deposit of the extent visualized when the investigation started.

In the field of strategic mineral exploration deposits of fluor spar, manganese, molybdenite, tin, tungsten and zinc in six provinces were diamond-drilled in 1942 and 1943, all costs being borne by the Dominion, which also bore the full cost of geophysical surveys for oil structures in Alberta and New Brunswick. Expenditures in 1943 were as follows:—

Bituminous Sands Drilling.. . . .	\$45,761.44
Strategic Minerals Drilling.. . . .	24,243.63
Geophysical Surveys.. . . .	38,901.34

Special Mineral Resources Investigations

In 1942 the Dominion commenced a technological investigation of the mining and separation of Alberta bituminous sands and of the kinds and qualities of products that could be derived therefrom. Solution of the complex problems confronting utilization of the sands for petroleum supply was found to require operation of a pilot or experimental plant and in 1943 the existing plant of Abasand Oils Limited near Fort McMurray, Alberta, was acquired for rebuilding and expansion to meet requirements of a suitable test plant. In 1944 test runs were commenced in the new separating plant and refining unit and continued until June, 1945, when fire destroyed part of the plant just as a new separating method was about to be employed. The separating unit is being rebuilt in order that tests may be completed. Although the Abasand refining unit is designed to produce mainly asphalt and lower-grade petroleum fuels, a refinery test run at Chicago using more expensive refining methods has shown that aviation and motor gasolines of standard quality can be produced

from the Alberta bitumen. Laboratory tests by the Bureau of Mines have demonstrated that a greatly increased yield of higher-value products can be obtained from the bitumen by hydrogenation. This work on the utilization of the bituminous sands is being entirely financed by the Dominion Government. Expenditure in the fiscal year 1943-44 amounted to \$766,712.84.

DOMINION FUEL BOARD

The Dominion Fuel Board was created by Order in Council in November, 1922, to meet a long recognized need for the co-ordination of governmental investigations bearing upon fuels and fuel problems, and for the purpose of advising upon, extending, and supplementing these investigations aimed at the solution of Canada's fuel problems. It was composed of the Deputy Minister of Mines, as Chairman, and senior officials of those Branches of the Departments of Mines and of the Interior that had been pursuing independent studies bearing upon certain phases of these problems; and its expenses were to be met from the Mines Branch appropriation.

The fuel problem of major concern at the time was that arising from the unsatisfactory supply situation resulting from the impact of war and post-war conditions upon Central Canada's long dependence upon American anthracite as a domestic heating fuel. Another problem was that of achieving a larger measure of Canadian self-sufficiency in fuel supply.

The attention of the Board was initially directed to the first of these problems, which was then particularly acute by reason of sharply rising prices, recurring shortages of supply, and deterioration in quality. The Board in its Second Progress Report in 1928 reported that it had undertaken a number of broad investigations which had contributed materially to the solution of the problem, which was effected by the introduction and increasing use of satisfactory alternative domestic heating fuels, including coke, British and other anthracites, low-volatile bituminous coals, and fuel oils. This problem was thus no longer causing concern.

Canada's major fuel problem had become one of developing greater use of Canadian coal in Central Canada; and investigatory and fact-finding work for the information of Government in formulating policy in that connection has since been an important function of the Board. The Board has also been charged with the responsibility of administering the assistance authorized by Parliament since that time to further the development of larger Canadian and other markets for Canadian coal, first, under the Domestic Fuel Act, 1927, subsidizing the construction of coke plants for the production of domestic coke; and, second, under a long succession of Orders in Council providing transportation and other subventions designed to enable Canadian coals to meet the laid-down price competition of imported coals at consuming points in Central Canada; and, in the case of British Columbia coals, to enable sales to be made in certain export and bunkering markets. The Board has provided the information on changing competitive conditions necessary to enable the subvention Orders in Council to be revised as required to assure the most effective employment of the assistance authorized.

Commencing in 1928 with a small assisted movement of Canadian coal, the administrative activities of the Board have been expanded until in the fiscal year ending March 31, 1938, they applied to assisted movements of

2,020,844 tons at Treasury costs amounting to \$1,865,589, and to subsidy expenditures of \$57,732 under the Domestic Fuel Act. This assisted movement further greatly increased to 3,646,887 tons during the next fiscal year.

The information and experience obtained by the Board in its long and close association with Canada's fuel problems were basic to the establishment of war-time coal control; and, in 1941, its powers, duties, and functions, with its staff and records, were accordingly transferred from the Mines and Geology Branch, and are now vested in the Coal Controller of the Department of Munitions and Supply.

4. LANDS, PARKS, AND FORESTS

The Lands, Parks, and Forests Branch administers the mineral, fur, and other natural resources of the Northwest and Yukon Territories, which Territories comprise approximately 40 per cent of the total area of the Dominion. The Branch deals also with any business arising from the local government of the two Territories. It administers the National Parks of Canada, gives a lead in the conservation of wildlife, marks historic sites of national importance, and assists in the encouragement of tourist travel. It conducts scientific investigations relating to the safeguarding, management, and maximum utilization of the Dominion's forest resources, for which work it maintains forest experimental stations and forest products laboratories. The Branch also maintains a Federal Land Registry Office.

The three bureaux of the Branch included in this discussion:

1. Bureau of Northwest Territories and Yukon Affairs.
2. National Parks Bureau.
3. Dominion Forest Service.

The activities of the bureaux are outlined in the following pages, and there are also special sections dealing with Wildlife and Tourist Travel to the extent that these subjects come within the purview of this Branch.

TERRITORIAL ADMINISTRATION

The Northwest Territories

The Northwest Territories Act (Chapter 142 R.S.C. 1927) provides for a Territorial Government composed of the Commissioner of the Northwest Territories, the Deputy Commissioner and five councillors appointed by the Governor General in Council. The Commissioner in Council has power to make ordinances for the Government of the Territories under instructions from the Governor General in Council or the Minister of Mines and Resources, respecting direct taxation within the Territories in order to raise revenues, etc., and in respect to the establishment and tenure of territorial offices; the appointment and payment of officers, maintenance of prisons, municipal institutions, licences, solemnization of marriages, property and civil rights, administration of justice; and generally to all matters of a local or private nature in the Territories. The seat of Government is at Ottawa.

The administration of the various acts, ordinances and regulations pertaining to the Northwest Territories, and also the administration of the natural resources therein is carried on in the Bureau of Northwest Terri-

tories and Yukon Affairs of the Lands, Parks, and Forests Branch. The care of the Indians is carried on by the Indian Affairs Branch of the Department in just the same manner as it is in the provinces. Several branches of the Department of Mines and Resources conduct basic surveys, such as geological, topographical, geodetic, legal, hydrographic, and waterpower surveys; forestry and wildlife surveys, mapping, and the interpretation of aerial photographs.

The Minister of Justice is Attorney General for the Northwest Territories. The Royal Canadian Mounted Police, functioning in association with the Department of Justice, looks after the administration of law and order. As the police are located at all main points of the Territories it is customary to ask the police officers to perform a great many administrative functions for government departments which are not adequately represented in the Territories. The Department of Fisheries administers the territorial fisheries and conducts biological investigations. The Department of Agriculture keeps in touch with those who can undertake gardening and farming, makes periodic investigations, and is establishing demonstration stations. The Department of Transport supervises airports and air harbours, aids to navigation and meteorological services, also provides some wireless service. The Department of National Defence through the Signal Corps maintains wireless communication and through the Air Force assists with aerial photography. The Post Office Department, through mail contracts, assists in the maintenance of communication and transportation. The Department of Public Works provides and maintains public buildings, administers the Navigable Waters Protection Act and makes river improvements, such as dredging, wharves, etc.

The Yukon Territory

The Yukon was created a separate Territory in June, 1898, by Act of Parliament (The Yukon Act). By amending legislation (Chapter 215 Revised Statutes of Canada 1927) provision is made for a local government composed of a Chief Executive, styled Commissioner (since classified Controller), also an Elective Legislative Council of three members with a three-year tenure of office. The Controller administers the Government of the Territory under instructions from the Governor General in Council or the Minister of Mines and Resources. The Controller in Council has power to make ordinances dealing with the imposition of local taxes, sale of liquor, preservation of game, establishment of territorial offices, maintenance of prisons and municipal institutions, issuing of licences, incorporation of companies, solemnization of marriages, property and civil rights, administration of justice, and generally all matters of a local nature in the Territory.

The Bureau of Northwest Territories and Yukon Affairs of the Lands, Parks, and Forests Branch, is responsible for business arising from the general administration of the Territory under the Yukon Act and Ordinances passed by the Territorial Council; for the disposal of lands under the Dominion Lands Act; for the administration of the Yukon Placer and Quartz Mining Acts; and for the collection of revenue. The Controller, Yukon Territory, is stationed in Dawson and represents all Dominion Departments having interests in the Yukon Territory. He is also head of the territorial or local administration, ex-officio mayor of

Dawson, and Registrar of Land Titles for Yukon Territory. There are three mining districts, Dawson, Mayo, and Whitehorse, with Mining Recorders in each. The Territorial Government maintains an assay office at Keno Hill, in the Mayo District.

Except for the fact that the Yukon Territorial Council is elective and the Northwest Territories Council is appointive the various government departments enumerated in the foregoing as aiding in the administration and development of the Northwest Territories extend similar service to the Yukon Territory.

The Northwest and Yukon Territories are included in the studies for the Dominion-Provincial Conference because they constitute a market for goods manufactured and crops raised in the provinces, and on the other hand the unmanufactured produce from these territories is processed in the provinces.

However, it might be noted that the provinces extend a certain amount of aid to territorial administration as the provincial services are more extensively organized and the provinces have established certain types of institutions which are lacking in the Territories. For example, upon application of territorial governments, provincial institutions receive for care and treatment territorial residents who are mentally unwell, incurables, those requiring highly specialized treatment, and in some cases prisoners for whom there is no accommodation in territorial jails. The territorial governments reimburse the provincial institutions for the actual cost of care and treatment. Provincial departments of education furnish correspondence school courses to residents of the territories and the provincial authorities are paid the actual cost of the service. In certain remote parts of the country provincial game officers also act as territorial game officers for the clearance of fur. The Saskatchewan Liquor Board acts as Liquor Agent for the Northwest Territories and operates the territorial stores at Yellowknife and Fort Smith. The Board is paid a commission on this business.

WILDLIFE

The Lands, Parks and Forests Branch is responsible for wildlife management in the Northwest Territories and in the National Parks and, less directly, in the Yukon Territory. This Branch also administers The Migratory Birds Convention Act.

The National Parks are natural outdoor museums of wildlife, which adds greatly to their attractiveness to tourist visitors. Administration of their wildlife resources is necessary to maintain the wildlife in a natural and healthy condition, to adjust the animal populations to the seasonal food supply, to keep interspecific relations within sound limits, to enable visitors to enjoy the wildlife without harming it or being harmed by it, and to build up reservoirs of wildlife to facilitate restocking of areas where this resource has been unduly reduced. Modern scientific investigation and advice is utilized to guide this administration to the best advantage.

In the Northwest and Yukon Territories management of wildlife seeks not only continuation and increase of a valuable resource, but also wise use of the resource for the maintenance of the native population and of many residents of mixed blood. Hunting and trapping are still basic industries in these territories. In the administration of territorial wildlife, harmony with the game and fur policies of adjoining provinces is always sought.

In the Yukon Territory hunting rights are available for any applicant who conforms to the regulations. In the Northwest Territories the pressure upon the wildlife resources has been so heavy that for some years past it has been necessary, for protection of the resident population dependent upon these resources, to restrict closely the increase in hunting and trapping rights.

The Migratory Birds Treaty between His Majesty and the United States of America was signed, with the consent of the several provinces, on August 16, 1916, and was made effective in Canada by The Migratory Birds Convention Act, passed by Parliament in 1917. The Minister of Mines and Resources is responsible for the fulfilment of Canada's obligations under this treaty, which is concerned with adequate protection of many kinds of birds that annually migrate back and forth between the Dominion and the United States. The administration of the Act and the Regulations under it is carried on, with provincial co-operation, by the National Parks Bureau of the Lands, Parks and Forests Branch, except that most of the responsibility for Dominion police work pertaining to enforcement of the Act and the Regulations rests with the Royal Canadian Mounted Police. The Regulations are amended annually, after full discussion with provincial game authorities of the changes proposed. Sixty-four bird sanctuaries, established in various parts of Canada, are administered by the Branch through the National Parks Bureau.

The Lands, Parks and Forests Branch maintains a general interest in conservation and utilization of wildlife as a national resource in all parts of Canada. It collects data on all phases of this subject, carries on scientific research on emergent problems, serves as an office of exchange of information for the game administrations of the several provinces, and places the findings and abilities of its scientifically trained personnel at the disposal of those administrations as far as possible when occasions for such action arise. In order to ensure adequate interchange of information about wildlife and its administration and the greatest possible unity of treatment of administrative problems in connection with this resource, this Branch arranges a biennial conference at Ottawa of provincial and Dominion Wildlife Officials. Problems of mutual interest are discussed; regulations and practice are compared; and scientific investigation is stimulated. The framework of continuing co-operation is developed.

International problems and contacts with respect to wildlife are also dealt with by the Lands, Parks and Forests Branch, for many of the constituent elements of wildlife management are global in character and in repercussions. Particular attention is, of course, given to the bordering countries, Newfoundland and the United States, with whom many of Canada's wildlife problems are directly shared.

In order that the knowledge and advice of Dominion Government officials with special training and experience in wildlife matters may readily be pooled and made available for consideration with respect to questions that arise from time to time in the administration of the wildlife resources under Dominion jurisdiction, such officials, from various Branches of the public service of Canada, were organized in December, 1916, as an Advisory Board on Wildlife Protection. This Board, the

secretarial office of which is maintained in the Lands, Parks and Forests Branch, continues to discharge with benefit the functions for which it was set up.

Administration of the Game Export Act, which was enacted by Parliament in June, 1941, to aid the provinces in controlling interprovincial and international shipments of game originating in Canada, also rests with the Lands, Parks and Forests Branch.

Each province maintains a game branch responsible for the administration of its wildlife resources. The Provincial Wildlife Statutes and Regulations deal with the following features as they may apply: administration of big game and fur-bearing animals; registered trap lines; registration of guides; fur farming; bounties on predatory animals; game propagation; fish culture; publicity on game resources and conservation methods; non-migratory game birds; provincial co-operation with the Dominion in administration of the Migratory Birds Convention Act and Regulations; interchange with the Dominion of information about wildlife as a means of bringing about more uniform procedure in connection with wildlife problems.

TOURIST TRAVEL

One of the most significant social and commercial developments of the present century has been the growth of the tourist industry. Once confined almost exclusively to the wealthy classes it now embraces practically every economic group, and had developed at the outbreak of the war to the point where it could justly be regarded as one of Canada's leading industries. This development has been due in the main to the following causes:—

1. The universal use, on this continent, of the automobile.
2. The great improvement in the quality and extent of public roads and highways which has been the direct result of the growth of the automobile industry.
3. A higher general standard of living and reduced costs of travel which have combined to bring tourist travel within the economic range of great masses of people.
4. General recognition that an annual vacation is not necessarily an expense but an investment in health, morale, and information.
5. The growing tendency, based on No. 4, of employers to allow certain periods each year with wages or salaries for vacations for their employees.

These principal reasons, along with other contributory causes, developed the tourist business to the point which it had reached at the outbreak of the war. The restrictions on travel which became necessary in countries committed to an all-out prosecution of the war resulted in a temporary set-back to the tourist industry, although it is a fact that at the present time the facilities for catering to tourists in this country are being strained to their utmost capacity. There can be no question that the removal of restrictions imposed by the war, and the mental reactions following the return of peace will enlarge the possibilities of tourist travel in Canada to a scale never before realized or even contemplated.

The advantages to Canada of increased tourist travel may be profitably summarized:—

(1) It will bring a large amount of foreign exchange into Canada, thus strengthening and stabilizing the position of Canadian currency on foreign markets.

(2) It will afford a large amount of employment in transporting, servicing, and accommodating tourists.

(3) It will afford a foreign market at home for many articles of Canadian production.

(4) It will be a means of informing and interesting foreign capitalists in the investment possibilities afforded by this country.

(5) It will enlarge the home market for practically all kinds of farm products.

(6) It will contribute directly to the provincial and dominion treasuries as a result of taxes paid by tourists while in Canada. (e.g. cigarette taxes, liquor taxes, gasoline taxes, sales taxes, fishing and hunting licences, etc.).

(7) Perhaps most important of all, it will contribute to an understanding of and friendship with the Canadian people on the part of the visitors from other lands. Nothing is so effective in the building of good will between nations as the fraternization of their nationals, particularly during their holidays and vacations.

Canada is in an exceptionally favourable position from which to develop a large international tourist travel. She is located alongside a great and wealthy nation, well disposed toward Canada, and much given to tourist travel. Particularly as a result of the war she now has also a status with other nations which she did not enjoy before. There can be no doubt that great numbers of citizens of many lands will welcome opportunities to visit Canada after the war provided that suitable facilities are made available and that the attractions which this country has to offer are adequately publicized.

Among these attractions none occupies a more important place than the national parks. These areas of outstanding beauty and abounding in other qualities which appeal to tourists are already well known among the travel-minded, and much more can be done in the future than in the past to publicize their attractions on a world-wide scale. Before this can be undertaken, however, with the fullest prospects of success, certain improvements and enlargements of facilities are necessary. Chief among these are:—

(1) More and better roads within the parks themselves.

(2) Very great extension and improvement of all public highways, particularly those connecting with main highways in the United States and leading to the areas in which the parks are located.

(3) Enlarged facilities for housing, feeding, and furnishing other services to tourists both in and out of the parks.

(4) The establishing and maintenance of graded standards of accommodation, whether under dominion, provincial, or municipal direction, or otherwise, which will assure the tourist a full dollar's value for each dollar expended.

Aside from its contributions through the National Parks Bureau the Dominion Government has established and maintained the Canadian Government Travel Bureau, through which channel substantial expenditures have been made with a view to promoting foreign travel in Canada. Substantial expenditures were also made by the Canadian Railways, Steamship Companies, and other transportation organizations, by Provincial Governments, Boards of Trade and Tourist Bureaux. These expenditures should be resumed and enlarged as soon as world conditions make that practicable, and expenditures should be co-ordinated, in so far as that may be possible, in order to get the highest possible efficiency in results.

What has been said in the foregoing about the Dominion Government and the national parks applies also although in varying proportions to the Provincial Legislatures and the provincial parks. Every Provincial Legislature has recognized the importance of the tourist industry by establishing its own provincial tourist bureau or government officers having the functions of a tourist bureau, and by voting sums of money for the promotion of the tourist industry within that province. There is a great range of difference in the expenditures made by the different provinces, but the principle is accepted by all. Most of the provinces also have established provincial parks, somewhat along the lines of the national parks referred to herein, but usually with less extensive development. The matter of co-ordinating Dominion and Provincial activities in the development of interprovincial and international tourist travel, mainly by means of establishing adequate graded facilities for the use of tourists; the development of national and provincial parks to the highest point of attractiveness consistent with the principles of conservation upon which they are based; and the devising and financing of publicity campaigns representing the experience and interests not only of the Dominion but of all the provincial units, surely presents a large and profitable field to be studied and explored by all the interests concerned.

NATIONAL PARKS

Canada's national parks are areas of outstanding beauty and interest which have been set aside by statute for public use. Originally established to maintain the primitive beauty and wonders of the landscape, they are also now conserving the native wildlife of the country, and preserving sites of national historic interest. As recreational areas their value is immeasurable, for they provide, in ideal surroundings, unequalled opportunities for the enjoyment of outdoor life.

Canada's national park system was instituted some sixty years ago, when a small area surrounding hot mineral springs at Banff in the Rocky Mountains was set aside in 1885 as a public possession.

The year 1930 was an epochal one in the progress and development of the national parks of Canada with the passing of the National Parks Act of May 30, 1930, and certain other Acts confirming agreements entered into between the Dominion Government and the governments of the western provinces relating to the transfer of the natural resources.

The National Parks Act emphasizes the inviolable nature of the parks of Canada and confirms to the people absolute ownership in the twenty scenic reservations and wild-life sanctuaries and seven historic parks

comprising over 29,300 square miles of territory (which includes the large Wood Buffalo Park in northern Alberta and the Northwest Territories with 17,300 square miles) constituting the National Park domain of Canada. Section 4 of the National Parks Act reads:

"The parks are hereby dedicated to the people of Canada for their benefit, education and enjoyment, subject to the provisions of this Act and Regulations, and such parks shall be maintained and made use of so as to leave them unimpaired for the enjoyment of future generations."

The following is a tabulation with a brief descriptive note of the National Parks and National Historic Parks of Canada:—

1. Mount Revelstoke, British Columbia. Rolling mountain-top plateau on west slope of the Selkirk Mountains. Accessible by motor road. Established 1914; area, 100 square miles.

2. Glacier, British Columbia. Superb alpine region in heart of Selkirk Mountains. Snow-capped peaks; glaciers, luxuriant flora. Established 1886; area, 521 square miles.

3. Yoho, British Columbia. On west slope of Rockies. High peaks, beautiful lakes, Yoho and Kicking Horse Valleys. Established 1886; area, 507 square miles.

4. Kootenay, British Columbia. Encloses Vermilion, Sinclair section of Banff-Windermere Highway in Rockies. Broad valleys, deep canyons, hot mineral springs. Established 1920; area, 587 square miles.

5. Jasper, Alberta. Immense playground and game sanctuary. Majestic peaks, ice-fields, beautiful lakes, and famous resort, Jasper. Summer and winter sports; golf. Established 1907; area, 4,200 square miles.

6. Banff, Alberta. Magnificent scenic playground in central Rockies. Noted resorts, Banff and Lake Louise. Summer and winter sports centre; golf; big game sanctuary. Established 1885; area, 2,585 square miles.

7. Waterton Lakes, Alberta. Canadian section, Waterton-Glacier International Peace Park. Mountain playground with colourful peaks, varied flora and fauna; golf. Established 1895; area, 220 square miles.

8. Nemiskam, Alberta. Fenced preserve for pronghorned antelope. Reserved 1915; established 1922; area, 8.5 square miles.

9. Elk Island, Alberta. Fenced preserve containing large herd of buffalo; also deer, elk and moose. Recreational and camping resort; golf. Reserved 1906; established 1913; area, 51.2 square miles.

10. Buffalo National Park, Wainwright, Alberta; 200.5 square miles now in use as a military training ground.

11. Wood Buffalo, Alberta, and N.W.T. Immense region of forests and open plains west of Slave River, between Athabaska and Great Slave Lakes. Large herd of buffalo and other big and small game. Established 1922; area, 17,300 square miles.

12. Prince Albert, Saskatchewan. Forested lakeland interlaced with numerous streams. Summer resort and recreational area; golf. Established 1927; area, 1,869 square miles.

13. Riding Mountain, Manitoba. Playground and game preserve on summit of Manitoba escarpment. Summer resort and recreational area; golf. Established 1929; area, 1,148 square miles.

14. Fort Prince of Wales, Manitoba. National Historic Park at Churchill. Ruins of fort built 1733-1771 by English to control Hudson Bay. Established 1941; area 50 acres.

15. Fort Malden, Ontario. National Historic Park with museum at Amherstburg. Defence post built by English, 1797-99 on Detroit River. Established 1941; area 3 acres.

16. Point Pelee, Ontario. Recreational area on Lake Erie, with fine beaches and unique flora. Resting point for migratory birds. Established 1918; area, 6.04 square miles.

17. Georgian Bay Islands, Ontario. Thirty islands in Georgian Bay. Unique formations on Flowerpot Island. Recreational area. Established 1929; area, 5.37 square miles.

18. St. Lawrence Islands, Ontario. Mainland area, and thirteen islands in "Thousand Islands" group with recreational facilities. Reserved 1904; established 1914; area, 185.6 acres.

19. Fort Wellington, Ontario. National Historic Park with museum at Prescott. Defence post built on St. Lawrence River 1812-13. Established 1941; area 8½ acres.

20. Fort Chambly, Quebec. National Historic Park with museum at Chambly Canton. Fort built by French 1665 on Richelieu River; rebuilt 1709-11. Established 1941; area, 2½ acres.

21. Fort Lennox, Quebec. National Historic Park with museum on Ile-aux-Noix, Richelieu River, near St. Johns. Fortifications built 1812-27 by English. Established 1941; area, 210 acres.

22. Fort Beauséjour, New Brunswick. National Historic Park with museum near Sackville. Site of French fort erected 1751-55. Established 1926; area, 59 acres.

23. Prince Edward Island. Strip 25 miles long on north shore of island province. Recreational area with fine beaches; golf. Established 1937; area, 7 square miles.

24. Port Royal, Nova Scotia. National Historic Park at Lower Granville. Restoration of the "Habitation" or first fort built 1605 by Champlain and De Monts. Established 1941; area, 17 acres.

25. Fort Anne, Nova Scotia. National Historic Park with museum at Annapolis Royal. Fort associated with early Acadian history. Established 1917; area, 31 acres.

26. Fortress of Louisbourg, Nova Scotia. National Historic Park with museum near Louisbourg. Ruins of walled city erected by the French 1720-40. Established 1941; area, 339½ acres.

27. Cape Breton Highlands, Nova Scotia. Rugged Cape Breton Island coastline with mountain background. Fine sea-scapes from highway; golf. Established 1936; area, 390 square miles.

In addition to the above, a large area of outstanding scenic mountain country in the southwestern Yukon on the Alaska Highway, described as the St. Elias-Kluane Reservation, comprising more than 10,000 square miles, was set aside by Order in Council P.C. No. 11142 dated 8th December, 1942, to prevent uncontrolled use and development brought about by the building of the Alaska Highway, with the view of eventually having the areas given the status of a national park for the future preservation of the flora and fauna and development for tourist purposes.

Other areas in the provinces of Quebec and New Brunswick have been examined at the request of their respective governments to determine their suitability as national parks.

It is usual to require the province to offer, free of all costs and without restriction, an area which shall be of outstanding interest from a national park standpoint. The Dominion then inspects the area in collaboration with a provincial representative and if it is deemed suitable for national park purposes, authority from Parliament is sought for the creation of a national park and thereafter the Dominion assumes 100 per cent responsibility for development and maintenance.

The question arises as to whether in the event of a province wishing to offer an area for establishment as a national park, the Dominion Government should still

require the province to put up 100 per cent of the cost of recapturing the rights which may have been alienated in the area.

At the present time most of the provinces have established provincial parks under provincial administration. The purpose is much the same, but regulations governing exploitation of the resources within the areas, such as wildlife, timber and minerals, vary in comparison to national parks and are not wholly inviolate in regard to use. Following is a list of the principal provincial parks by provinces:—

British Columbia

There are three classifications of parks—Class “A”, with 16; Class “B”, with 3; and Class “C”, with 28, representing a total of 47 units with a combined area of 11,480 square miles. In addition, there are three parks, known as Special Act parks, with a total area of 2,604 square miles.

Alberta

Although Alberta has a larger area of national parks than any other province, many small recreational and picnic park areas have also been set apart by the Provincial Government. These include 17 sites with a total acreage of approximately 6,919 acres.

Saskatchewan

Seven permanent park reserves or recreational areas are distributed over the forested sections of the province, with a combined area of approximately 1,684 square miles.

Manitoba

Although Manitoba has many areas attractive to the sightseer and vacationist, the province has as yet established officially only one which may be described as a provincial park. This is an area of 1,088 square miles, known as the Whiteshell Forest Reserve.

Ontario

There are six provincial parks in Ontario, with a total area of approximately 5,070 square miles, much of which is wilderness country with good camping facilities established at accessible points.

Quebec

There are four provincial parks in this province, located in distinctive areas which enables each to offer some special interest. Provision for accommodation and tourist facilities have been sponsored by the Provincial Government. The total area included in provincial parks is approximately 5,365 square miles.

Maritimes

Apart from the national parks established by the Dominion Government in Prince Edward Island and Nova Scotia and national historic parks in New Brunswick and Nova Scotia, and a number of small civic parks and recreational areas, these provinces have no provincial park areas.

General

The part which the national parks and provincial tourist centres have played in making Canada known throughout the world, and in attracting the interest and capital of people from other lands, can hardly be over-stated. Through publicity which has been originated, not only by the federal Government, but by the

Canadian railways, steamship companies, and other transportation organizations, by provincial governments, boards of trade and tourist bureaux, the national parks have been made known in practically all civilized countries. They have attracted thousands of tourists, prominent people in their own lands, who have gone home with an appreciation of Canada which they would not otherwise have had. In many cases these visitors have been investors who, because of their travels in Canada, have become financially interested in this country.

Before drastic restrictions were placed on train and motor travel due to war needs, the value to the tourist industry in Canada was estimated at a very considerable figure. The tourist attendance at national parks reached an all-time high of 1,000,563 in 1941 before these restrictions were put into force, but since then there has been a sharp decline. Indications are that with the lifting of restrictions in the post-war years the attendance at national parks throughout the country will greatly exceed the above figure and will tax facilities to the limit. The tourist lure of national parks contributes in no small measure to the economy of the country at large.

The contact of tourists with Canadians has had a broadening effect upon both. This has been particularly true of the association established with visitors from the United States; indeed, it is probably not too much to say that the present friendly relations of these two countries through interchange of travel have been of vital importance in the successful prosecution of the war.

The parks are also of great importance in furnishing facilities for the recreation of the Canadian people; as a means of maintaining the health and morale of the populace; and for the services they render in the maintenance or restoration of the health of members of the Armed Forces.

The services which the parks have already rendered are an indication of what can be done, on a much larger scale, during the post-war period. Plans have been drawn up for substantial improvement and expansion of national parks to extend their usefulness along the lines already indicated, while at the same time furnishing employment in the post-war period.

FORESTRY

Forests have always played an important part in the Canadian economy. Under any planned land-use policy they will continue to do so because, within the boundaries of the nine provinces, over 58 per cent of the total land area is now occupied by forests, most of which will yield its highest return if utilized for the production of trees. Less than 27 per cent of the provincial area is considered suitable for agriculture.

Canada is one of the great timber-producing countries of the world, and wood and wood products are manufactured greatly in excess of local requirement. The surplus is exported and constitutes one of the main items in our favourable balance of trade.

Before World War II the amount of timber cut for use or destroyed by fire, insects, or disease, totalled about four billion (4,000,000,000) cubic feet annually. The amount cut for use was about 70 per cent, and that destroyed 30 per cent, of this total. During the

war, the cut has been increased so that the total drain on the forest exceeds the above figures by about 30 per cent.

Factual data on total supplies of timber, losses by fires, insects, and disease, rate of growth, etc., are inadequate to determine whether or not the new growth is sufficient to replace total depletion. However, there can be little doubt that, during the war years, depletion has been in excess of growth. Excess cutting can be justified due to the exigency of war and may have to continue for a few years at least, during the reconstruction period. Nevertheless, it is to be expected that this policy of over-cutting will increase the difficulties of Governments and industry in their attempts to place Canada's forests on a basis of sustained yield.

Some conception of the value of the forest resources and forest industries based on them may be obtained from the following statistics for the years 1937 and 1942. Figures for the two years are given in order to show conditions in typical pre-war and war years.

FOREST INDUSTRIES¹

	1937	1942
Capital Invested	\$946,854,718	\$1,201,106,201
Employment, man-years ...	210,351	260,000
Salaries and Wages paid....	175,945,922	348,826,270
Net Value of Products.....	350,698,674	559,901,118

¹ Including woods operations, sawmilling, pulp and paper making and miscellaneous wood and paper using industries, except the printing trades.

The above statistics indicate the value of wood products only. There are other values which are no less real but not susceptible to a dollar valuation. These include,

Watershed protection—Forests influence the movement of water after it has been precipitated. They provide storage and prevent rapid run-off, thus reducing losses by erosion and floods.

Recreation—The importance of forests to any park or other recreational area need not be elaborated. To a major extent the level of the tourist industry depends upon their existence.

Wild Life—The forests provide the environment essential to the conservation of fish, fur, and game.

Dominion Activities

From the time of its inception, some 45 years ago, until the transfer of the natural resources to the western provinces in 1930, one of the important activities of the federal Forest Service consisted in the protection and administration of forest lands controlled by the Dominion in western Canada. Inasmuch as the exercise of this particular function is now a provincial responsibility, the resources transfer had considerable effect upon the organization and work of the federal Forest Service. The duties which remain, however, are, from the broader national standpoint, of tremendous significance, and, in the long run, of much greater importance.

Transfer of the resources resulted in a material reduction in staff in western Canada, and an accompanying decrease in expenditure, but the federal government still has Dominion-wide obligations in forestry which must be met. As a matter of fact, the transfer leaves the Dominion with obligations for the advancement of forestry directly comparable to its obligations in the

fields of agriculture and mining, where federal activity is concentrated on investigation, research, experiment, and leadership to the provinces and to industry.

The need for federal leadership in the field of conservation was recognized in 1909, at which time the Government of the day passed an act establishing The Commission for Conservation of Natural Resources. Forestry research constituted an important phase of the Commission's work, up until the time of its abolition in 1922 when the Federal Forest Service absorbed the forestry function of the Conservation Commission which it has since enlarged, improved on and consolidated. The need for a federal co-ordinating agency is even more important today than it was some 36 years ago.

With the steady decrease in the wood capital of the Dominion, resulting from extravagant exploitation and losses through fire, insects, and disease, during the past 70 years, it has become increasingly evident that if the forest industry is to be maintained at even a reasonable level of production, more effective methods of operation based on scientific forestry knowledge must be applied to balance depletion and growth. This economic necessity of preserving capital by operating on annual interest (growth), as observed in most business enterprises, has not yet been applied to Canada's forest business.

The application of this principle must be founded not only on a systematic inventory of the character, distribution, and amount of timber throughout the Dominion, but also upon a thoroughly scientific investigation of all factors relating to the growth and use of timber. The advancement of scientific knowledge and the development of cultural methods based thereon are just as important in the sustaining of forest industry as they are in the field of agriculture, and they are just as truly federal functions.

Forest Economics

Forest statistics secured from the Dominion Bureau of Statistics, provincial authorities, and other sources are subjected to comprehensive analyses. Tabulations are made of the latest estimates of the forest resources, depletion due to cutting, and losses due to fire, insects, and diseases. Calculations are made to determine the amount of growth necessary to balance depletion. Records are maintained and special studies undertaken to determine the incidence of prices, tariffs, taxation, and insurance on the forest industries. The Forest Service endeavours to keep up-to-date with respect to the trends of forest industry, in both the national and world-wide aspects, with a view to stabilization and adaptation of processes to domestic and foreign market requirements. Special reports are prepared, from time to time, for other federal departments of Government and much material of direct value to the provinces, industry, and the public is publicized through articles, papers, and addresses.

Forest Inventory

While forest authorities in Canada are aware that the situation with regard to timber supplies is serious, nevertheless the fact remains that there are not available definite and complete data regarding the quantities of merchantable timber and young growth or the extent of depletion through use of industry or wastage by fires, insects, and disease.

Up to June, 1929, sporadic and local attempts were made to obtain these data. On that date a special conference of federal and provincial executives was called at which it was agreed that the federal service would act as the co-ordinating agency, both in the standardization of survey methods and in the compilation of the data secured. Responsibility for the actual stock-taking was assumed by the provinces. Considerable progress has been made on this division of responsibility but the task is far from complete. A progressive stock-taking of the forest resources of Canada is being carried on, secured through;—

- (a) Assembly and compilation of data received from the provinces, industry, and other sources;
- (b) Volumetric estimates of timber stands through the interpretation of aerial photographs, following a special technique devised in the Dominion Forest Service.

Only the Dominion Government can compile a national forest inventory. The principal data are secured from provincial sources, but these have to be analyzed, compared, discrepancies ironed out, and gaps filled in.

Since the development by the Dominion Forest Service of a technique for measuring the volume of timber stands through the interpretation of aerial photographs, the possibility of securing a national inventory within a reasonable time and at a reasonable cost has greatly increased. The information secured from aerial photographs must be plotted on accurate base maps made from aerial photographs. The development of this new technique does not alter the lines of procedure agreed on with the provinces in 1929. It has made possible, however, a new approach to the inventory problem according to which the Dominion has undertaken in some cases the preparation of basic inventory maps showing a classification of the forests by broad types—softwoods, mixedwoods, and hardwoods—and the division of these types into broad volume classes. Such basic maps can be used by the provinces and by forest industry as a foundation on which to build up whatever more detailed information they desire for management or operating purposes. This technique has already been applied with success in some provincial areas as well as in the northern territories and national parks and has proved of great value in expediting the collection of accurate data on forest resources. The aerial photographic method is particularly well adapted to making the periodic revisions which must be an essential feature of any satisfactory forest inventory. Final responsibility for detailed statements respecting the forests under their control continues to rest with the individual provinces.

Silvicultural Research

Forestry is a long-term undertaking, and it will not suffice to wait until our present supplies are gone and then begin the building up of a new forest estate. Canada must look ahead and lay plans for the future—plans based not on present supplies or present values but rather upon a critical analysis of the situation as it will exist in the years to come. It was the realization of this situation that impelled the federal Forest Service some 25 years ago to inaugurate a program of silvicultural research. For this a strong organization was built up operating in most of the provinces. Although there are isolated researches which have been carried on by individual provincial services, the general field

is one with which the federal authority has been primarily concerned.

Silvicultural problems are regional in character and overlap provincial boundaries. The provincial forest services are beset by the pressing details of forest administration and protection, and the fact that the application of the results of research may not in all cases be economically feasible at the present time renders it extremely difficult for the provincial organization to attack some of the most fundamental and far-reaching silvicultural problems.

The development of scientific forestry in Europe gives some leads, but the results obtained there cannot be applied generally under Canadian conditions, as we have to deal here with different trees species, growing under different climatic conditions. For this reason, the Forest Service has had to start practically at the beginning and build up a research technique of its own. The leadership of the federal Forest Service in silvicultural research has long been recognized by the provinces.

Experience in other countries has demonstrated that an essential feature of the work of silvicultural research is the delineation of geographical regions in which special forest types or groups of types may be subjected to intensive scientific study, including not only growth conditions but also their reactions to various methods of treatment, for the purpose of determining the proper practice to secure sustained yield. This gives rise to the necessity for establishing forest experiment stations in the important forest regions. Field research and experimental work may take place either on such stations or on the timberlands of the provinces or of industrial concerns whose co-operation has been secured. It is obvious that this phase of federal forest activity closely parallels the work accomplished in the Department of Agriculture through experimental farms. The value to Canada of similar work in forestry will not be less proportionately than that which has been secured in the field of agriculture.

Typical of the silvicultural research activities carried on by the Dominion Forest Service are the following:—

- (a) Forest mensuration which involves the measurement of trees, stands, and forest products. This includes the development of standard volume and yield tables for use in timber estimating in various parts of Canada; the study of converting factors between different units of measurement of timber; analysis of log scales and investigations with a view to standardization thereof.
- (b) Preparation of scientific forest working plans for application to areas which are to be brought under intensive forest management.
- (c) Cultural treatment of stands by thinning and pruning to improve volume and quality production.
- (d) Development of silvicultural cutting methods to secure natural regeneration.
- (e) Studies in tree-breeding and vegetative propagation of promising individual or hybrid tree species.
- (f) Studies in the technique of reforesting devastated land having regard to the most suitable species adaptable to the various sites.
- (g) Studies to determine the suitability of exotic tree species to Canadian conditions.

The above activities indicate the kind of work carried out on the five Dominion Forest Experiment Stations established on lands turned over to the Dominion Forest Service by the Department of National Defence or by provinces. These stations, selected on the basis of representing conditions in the forest regions in which they are located, are as follows:—

Acadia Forest Experiment Station

This area is suited to a study of the softwood types occurring in the Maritime Provinces. The principal species studied are white and red spruce growing in both softwood and mixedwood types. The experimental area contains 38 square miles and lies 15 miles northeast of Fredericton, N.B.

Valcartier Forest Experiment Station

This station is representative of the mixed hardwood types, and to some extent, the spruce type, in the Province of Quebec. It is $7\frac{1}{2}$ square miles in area and located some 17 miles north of Quebec City.

Petawawa Forest Experiment Station

This station serves for investigation of problems associated with the management of the pine and hardwood types in Eastern Canada. The area of approximately 100 square miles comprises part of the Petawawa Military Camp. It is located northwest of Pembroke, Ontario.

Riding Mountain Forest Experiment Station

This station is representative of the aspen-grove and mixedwood belts in which white spruce and aspen are predominant. The area of 25 square miles comprises part of the Riding Mountain National Park, located in the western part of the Province of Manitoba.

Kananaskis Forest Experiment Station

This station affords an opportunity for the study of lodgepole pine in association with spruce, one of the most important timber types found in the Rocky Mountain region. This area of approximately 63 square miles lies wholly within the Kananaskis Valley, with headquarters about 62 miles west of the city of Calgary.

These stations are staffed with personnel, both permanent and seasonal, for the purposes of administration, timber disposal and protection against fire.

The Petawawa area is Canada's chief forest experiment station and as such has attracted national and international attention. Established more than 25 years ago, it is now operating on a sustained yield basis, and during the past five years has yielded substantial revenue, while at the same time providing much-needed timber supplies for the war effort, including lumber, pulpwood, match-stock, fuelwood, telephone and transmission poles, etc.

The Kananaskis Station has likewise functioned to assist the war effort by supplying mine-timbers for the coal mines of Alberta, fuelwood for the war industries as well as for the internment and military camps in Alberta, and yielded substantial revenue in the process.

These two areas, together with the Acadia Station, provided locations for internment and prisoner-of-war camps, and co-operated with the Departments of National Defence and Labour in providing useful employment for prisoners of war and conscientious objectors within their boundaries.

Other activities of the Forest Service conducted outside the experiment stations include:—

- (a) A forest classification dividing Canada into broad zones and sub-zones, in each of which there is a high degree of similarity of growing conditions.
- (b) Rate-of-growth surveys across Canada were undertaken following an agreement reached at a conference with the provinces in 1929.
- (c) Studies in site-type classification—these involve the assessment of the tree-growing capacity of any area based on the flora present on the forest floor.
- (d) Studies of management problems are conducted and advice provided covering lands operated by provincial governments and forest operators.

Information gathered in all these activities is published and made available to governments and industry.

Forest Products Research

The products of our forest industries are sold on world markets which are highly competitive. They are faced, both in the United States and in European markets, with the products of other nations whose industries have back of them large and efficient research organizations sustained by the State. Our Canadian forest products compare intrinsically, in value, very favourably with those which can be produced in any other country. Canada is, however, far behind in providing industry with research facilities for the management of forests to ensure continuity of cheap raw material supplies, and for the better manufacture of forest products.

Since 1913, through the medium of Forest Products Laboratories, forest products research has been carried out in Canada as a federal function, as is the case in the United States, United Kingdom, Australia, New Zealand, South Africa, India, and other countries.

The problems are of country-wide significance, many indeed are international in scope, involving co-operation with other laboratories, such as, for example, the maintenance of international standards for testing timber.

The Forest Products Laboratories function to promote more efficient use of wood, to devise means of curtailing waste, to develop use for species now left in the woods, to improve manufacturing techniques with a view to cost reduction, to improve grading practice, timber specifications for building codes and engineering standards in timber design, and to increase the life of timber by chemical treatment and by many other ways.

The value of wood as a basic commodity has become increasingly evident as a result of war experience. Substitution of wood or products derived from wood for other strategic materials in tight supply has resulted in many new uses. Canada, with its large proportion of land area suitable only for growing wood crops, must keep in the forefront in new developments in moulded plywoods, plastics, compressed wood, laminated members to replace large structural sizes, fire-retardant treatments, and improvement in pulping practices for both mechanical and chemical pulp.

The provinces and industry are a unit in assigning forest products research as primarily a Dominion function and demanding much greater attention in this important field.

The Laboratories have promoted the better utilization of the forest resources of Canada, as, for example, in the following directions:—

1. By finding more efficient methods of manufacture of woods.
2. By the elimination or utilization of the waste in manufacturing and logging. The latter, in particular involves not only waste of up to twenty per cent in species cut, but further economic losses in species not logged. (The resulting debris is perhaps the most serious fire hazard forest protection authorities have to contend with.)
3. By finding, through a study of their mechanical and physical properties, uses for woods not now commercially valuable.
4. By finding more valuable uses for woods which are now used to make lower grade commodities.
5. By ascertaining if Canadian woods, either in their natural state or after treatment, may be substituted for imported woods.
6. By studying and developing the fundamental principles underlying the treatment of wood and its use in the manufacture of fibre products, alcohol, turpentine, resin, tar, etc.
7. By serving as a public bureau of information on the properties and utilization of forest products.
8. By the application of laboratory findings to the standardization of lumber grades and the improvement of timber specifications in building codes of Canadian cities.
9. By co-operating with the consumers of forest products in improving present methods of use and in formulating specifications and grading rules for commercial woods, material secured from them (gums, oils, resin, etc.), and material used in the treatment of wood (creosote, zinc chloride, and other preservatives).
10. By assisting industry in refinements in manufacture so as to curtail the export from Canada of raw or only partially manufactured material.
11. By studying closely existing methods of pulp and paper manufacture and the woods now used for pulp and paper, with the end in view of improving present practice, curtailing waste, and finding methods of using woods not now considered of value for such purposes.

Forest Protection

The transfer of the natural resources to the Western Provinces in 1930 relieved the Forest Service of direct administrative responsibility for the protection of any extensive forest area. There remains, however, the protection of the forest lands comprising the various forest experiment stations. In addition to the actual timber values which must be safeguarded on those stations, there is a very large investment in scientific work which has been performed in some cases over a considerable period of years. This results in the necessity of affording a much higher degree of fire protection than the timber values themselves might perhaps justify. In the circumstances everything is being done to meet this requirement, but there is still need for further facilities in the way of forest improvements, permanent personnel and equipment to make these areas fireproof.

These experiment stations, which are established primarily for silvicultural research, afford a unique opportunity for experimentation in forest protection equipment, facilities and methods. The Petawawa Station in particular has served as a valuable proving ground in the development, testing and application of fire-fighting equipment.

In 1926 a forest fire research program was initiated by the Forest Service at this Station. This scientific approach to fire prevention consisted of the study and investigation of the influence of weather factors upon the inflammability of the materials composing the forest floor in which fires start and spread. The moisture content of these forest fuels depends entirely upon the weather. By observing the relationship which exists between moisture contents of these materials and various weather factors, tables were developed for computing an index or measure of forest inflammability. The object of the study was to provide an accurate prediction or fire weather forecast. This technique has proved of extreme practical value, and is now in effective operation in the provinces of New Brunswick and Quebec and the National Parks of Canada. Requests have been received by the Forest Service for the extension of this system to other provincial forests. In the conduct of these studies on forest fire hazard research weather records play an important part, and to this end the Forest Service has worked in very close co-operation with the Meteorological Branch of the Department of Transport.

Another important function of the Dominion Forest Service is the preparation and publication each year of the national forest fire statistics. The records are secured each year from the provinces, analyzed and compiled for the country as a whole. This function is the result of an arrangement agreed on at a forest fire conference of the Dominion and Provincial Ministers, Deputy Ministers and officials in January, 1924, whereby the responsibility for the collection, correlation and dissemination of national fire statistics was assigned to the Federal Forest Service. The net result of this arrangement has been a complete record by provinces of the forest fire losses and damage throughout Canada for the past 20 years.

The principal impediment to the introduction of forestry principles in woodland management is the threat of loss through fire. The additional cost involved can only be justified when fire protection reaches the stage that forests become an insurable asset. Consequently fire protection research renders an extremely important service.

Experience has proven that the detection and suppression of forest fires alone is not adequate to control the situation under the conditions governing in Canada today. The vital fact is that 85 per cent of all fires are the result of human carelessness or neglect. Until this state of mind is changed to one of regard and care for the forest estate by the general public, no solution is possible. The federal Government through the Forest Service, has for years past realized this and initiated and fostered forest fire prevention propaganda in the press, in the schools and through other media across the Dominion. To assist in this work the federal Government also has for years past provided an annual grant to assist the Canadian Forestry Association whose full time and effort are devoted to fire prevention throughout Canada.

Fire is not the sole enemy of the forest. Insects and disease likewise take a heavy toll of our forests. This phase of protection has to date been chiefly the function of the Department of Agriculture. This effort has been confined to biological studies of the insects or disease organism and the devising of control measures. However, the entomologists agree that the prevention of serious outbreaks can only come through the application of proper silvicultural methods which will keep the forests in a healthy condition. With this object in mind the Dominion Forest Service is co-operating directly with the Department of Agriculture.

Dominion Forest Service Co-operation

The Dominion Forest Service has for a number of years co-operated with international, national and provincial organizations in the field of forestry and forest research.

In the international field officers of this Service acted as independent experts on the Technical Committee on Forestry of the Interim Commission of the International Organization of Food and Agriculture at Washington, U.S.A. The purpose of this committee was to make recommendations respecting the desirability of setting up a permanent international forestry organization as an integral part of a proposed Food and Agriculture Organization.

This Service also maintains a direct contact with the Forest Services of British Empire countries, the United States, and, to a lesser degree, with other foreign countries. During the past five years in particular the Forest Products Laboratories of this Service worked in close co-operation with the U.S. Forest Service Laboratories, and participated in the joint U.S.-Canada Committee on Wooden Aircraft Mission to Great Britain. Great Britain sent a return mission to Canada to study developments in this work.

In the national field the Forest Service works in close co-operation with the following Government Departments:—

Department of Trade and Commerce.—Information with respect to forests and forest products of Canada are supplied to the accredited representatives abroad, and also close co-operation is maintained with the Bureau of Statistics in the compilation of forest statistics.

Department of National War Services.—Co-operation was maintained with the National Film Board in the production of motion pictures dealing with the forest resource, and with the Canadian Broadcasting Corporation in the preparation and dissemination of broadcasts dealing with forestry.

Department of Munitions and Supply.—Officers of the Forest Service contributed substantially with expert advice and direct assistance to the Timber Controller. The Dominion Forester was charged with the organization and administration of the Wood Fuel Control.

Department of Labour.—In 1939 the Forest Service co-operated with the Federal Department of Labour and the Provinces in a National Forestry Program designed to rehabilitate and provide training and useful work for young men between the ages of 18 and 25 years. Under this plan the work was carried on by all the provincial governments through agreements made with the Dominion, by which the costs were shared.

In 1942 and 1943 this Service co-operated with the National War Services and the Department of Labour in the operation of work camps in the Province of British Columbia for conscientious objectors. The camps were operated under agreement between the federal and provincial governments in which this Service acted as the Federal agent. The purpose of this project was to provide protection to British Columbia coast forests in any emergency arising out of threatened enemy action.

Department of Transport.—Co-operation is maintained with the Meteorological Branch of that Department in the prosecution of forest fire weather forecasts.

Department of National Defence.—Prisoner-of-war camps were established on three forest experiment stations where useful work was supplied for the employment of prisoners, largely to supply fuelwood for such establishments and for military training camps.

Department of Agriculture.—The Forest Service works in close co-operation with the entomologists of that Department by providing advice and direct assistance in an endeavour to control insect outbreaks through the application of silvicultural methods.

Department of Mines and Resources.—In addition to the above, the Forest Service supplied expert advice and assistance to its own Department, particularly in the National Parks, for the design and installation of fire protection systems and the establishment of forest fire weather stations. Similar assistance was rendered to the Northwest Territories Bureau in the organization of that vast area for protection, and in the administration of its timber resources. The Indian Affairs Branch was also provided with advice and assistance by this Service in the administration and disposal of timber on Indian lands.

In the provincial field, close liaison is maintained with provincial forest organizations, particularly during the war, when this Service represented the provinces in claims for taxation exemption for fire-fighters. The Forest Service also arranged with the federal departments concerned for the control of vital fire-fighting equipment and the allotment of gas, oil, transport, and other facilities through the central control agencies at Ottawa, to assure the maximum assistance to provincial forest fire protection effort. Representations were also made to the Department of Labour to assist these organizations in obtaining a reasonable degree of man-power for their protection requirements.

Provincial Activities

The main forest regions of Canada belong to the provinces. With the exception of Prince Edward Island, each maintains its own Forest Service for the administration and protection of its forest resources.

The chief functions of these services are as follows:—

Forest protection

Undoubtedly fire protection constitutes the biggest problem facing provincial forest authorities today on account of the vast areas involved, the high fire danger, and the lack of public awareness of the need. Provincial protection systems have required years to bring them to their present standards. However, in 1944 the total damage and cost of forest fires on provincial lands amounted to some \$7,400,000 as compared to an average annual loss for the past 20 years of some \$4,800,000. These figures emphasize the inadequacy of present

organizations to cope with the fire problem. Between 1923 and 1931 considerable progress was made in extending organization and in the development of fire-fighting equipment and technique. However, during the depression years which followed, and nearly six years of war, protection organizations have suffered severe setbacks and the forest fire situation in Canada can well be described to-day as it was described in the deliberations of the British Empire Forestry Conference as "unsatisfactory".

To meet this situation each of the provinces is organized by forest districts, sub-districts, ranger districts, patrol areas, all staffed by both permanent and seasonal employees. Facilities in the way of look-outs, telephone and radio, fire-fighting equipment, transport are used in conjunction with roads, trails, cabins and other forest improvements to supply fire protection. Two provinces maintain their own provincial air services and the others purchase flying when a fire emergency arises.

Probably the greatest need of fire protection in the provinces is the construction of more forest improvements, particularly forest truck roads to open up presently extensive inaccessible forest areas.

Nearly all the provinces sponsor educational programs by means of radio, press, posters, schools, etc., to enlighten public opinion and solicit co-operation in protection. Woods travel is controlled during periods of high fire hazard by means of travel permits.

Forest Management

It has been the policy of practically all provinces to dispose of the rights to cut Crown timber by sale or licence. In nearly all cases these rights to cut are granted for areas which are merchantable. After the timber is logged the sale or licence is usually terminated. The conditions of the sale or licence are modified from time to time, and in recent years attempts have been made to regulate cutting so that the forest may regenerate itself.

One province requires operators holding licences for large areas to prepare, and submit for approval, working plans designed to ensure the orderly conduct of operations. These working plans also make some provision for the practice of silviculture. Doubtless this policy of working plan management will extend to other provinces. To improve the effectiveness of such plans more silvicultural knowledge must be obtained through research, and future forest management will be governed by advances made in that field.

Most of the provinces have from time to time undertaken some silvicultural research work. Such work, however, has lacked continuity and has been intended for the solution of individual management problems. By and large basic silvicultural research is recognized by the provinces to be a logical function of the Dominion.

A number of provinces have adopted the policy of establishing forest reserves. Such areas are considered of primary value for forestry purposes and unsuitable for land settlement. These are managed more intensively than other Crown lands and a few of them are operated on a sustained-yield basis.

Most provinces maintain one or more tree nurseries where stock is grown to reforest areas which have failed to regenerate satisfactorily or waste lands which have followed attempts to grow agricultural crops. Planting

stock is also supplied free of charge to farmers by some provinces, for the establishment and maintenance of woodlots and shelterbelts. Two of the provinces maintain forestry extension services to give advice and direction in the handling of farm woodlots.

Forest Economics

Individual provinces compile statistics relating to production of their forests and forest industries, such statistics being more or less supplementary to those compiled by the Dominion Bureau of Statistics. There is no uniformity in this provincial effort.

Special studies of economic problems have been undertaken by individual provinces from time to time, and in recent years there has been a tendency to increase this type of work. Some provinces have endeavoured to promote better marketing of their forest products by contributing to the support of trade commissioners abroad.

Forest Products Research

The provinces and industry are a unit in assigning forest products research as, primarily, a Dominion function. Only one province undertakes work in this field.

Forest Inventory

All provinces have devoted time and funds to collect information on the character and distribution of their forests and the quantities of merchantable timber available. In no province is this information complete and even when completed it will require continuous revision because of changes brought about by cutting, fire, insects and diseases, and by new growth.

Although ground survey methods are still being used to gather this information in some provinces, others have supplemented these by use of the aerial photographic technique.

Summary

The forestry problem of Canada is one of such magnitude that it demands the concerted efforts of all interested agencies, including the Federal and Provincial Governments, the wood-using industries, the financial institutions supporting those industries, and the general public.

The foregoing statements outline the Dominion and Provincial activities in the forestry field. There is little if any overlapping of work, and duplication of effort is avoided through consultation and close co-operation between the Dominion and provincial authorities.

5. SURVEYS AND ENGINEERING

The Surveys and Engineering Branch is made up of a number of well-defined scientific and technical services, functioning under direction in their particular lines of work and undertaking related activities that may develop from time to time.

The Services making up the Branch are as follows:

1. Dominion Observatories—
 Dominion Observatory, Ottawa
 Dominion Astrophysical Observatory, Victoria
2. Dominion Water and Power Bureau
3. Engineering and Construction Service
4. Geodetic Service
5. International Boundary Commission
6. Hydrographic Service
7. Legal Surveys and Map Service

DOMINION OBSERVATORIES

The above services, or major divisions, function under the administrative supervision of the Director of the Branch. The official names of these services indicate the general nature of their activities and these are summarized as follows:—

The Dominion Observatory at Ottawa functions in the fields of seismology, terrestrial magnetism, gravity, astro-physics, solar physics, and position astronomy which includes time service for the Dominion.

The Dominion Astrophysical Observatory at Victoria has for its chief objective research in astronomy and astro-physics as a national contribution to world knowledge.

The Dominion Water and Power Bureau investigates, records, and analyses the water and power resources of Canada as a whole, placing the data obtained in convenient form for reference and for use in matters relative to hydro-electric development, international water problems, and water resources generally.

The Engineering and Construction Service supplies information and advice on engineering matters to all Branches of the Department of Mines and Resources, including engineering investigations of construction projects in National Park areas and Indian Reserves, and the supervision of highway development across Canada in cases where the Dominion may make financial contributions.

The Geodetic Service provides horizontal and vertical control throughout Canada for mapping, engineering and all development purposes, by determining with the highest accuracy the position of selected points throughout the country by triangulation, by astronomical observations, and by precise level lines. The position data so obtained assist in survey work of all kinds, whether carried on by Dominion, provincial, or municipal governments, or by private firms or persons.

The International Boundary Commission is responsible for the demarcation and maintenance of the International Boundary between Canada and the United States and Canada and Alaska, this work being a statutory obligation under the treaties between Canada and the United States.

The Hydrographic Service undertakes the surveys of water routes and harbours in the Dominion and from these prepares navigation charts for the guidance and use of all shipping. Tide tables for Canada are also calculated and issued annually, and precise water levels taken in the Great Lakes area.

The Legal Surveys and Map Service functions in two main fields. It is responsible for the making of legal surveys of Dominion lands across Canada, including National Parks, Indian Reserves and the Yukon and Northwest Territories. It is also responsible for the compilation and printing of maps and plans for general purposes and for air navigation. General purpose maps include those of a national character, such as maps of Canada, or large sections of Canada; maps showing railway or highway systems in Canada; and maps of the world showing trade routes. Special maps are prepared and printed from time to time for the use of various Departments of Government.

The following pages include a more detailed description of the functions and actual activities of the above Services.

The work of the observatories at Ottawa and Victoria covers the fields of astronomy (including astrophysics and solar physics) and geophysics. In general the aim is to conduct research and to develop practical applications as the need arises or the opportunity offers. The work of the Dominion Observatory at Ottawa falls under the divisions of Astronomy of Position (including Time Service), Seismology, Terrestrial Magnetism, Gravity, Astrophysics, and Solar Physics. All of these except Astrophysics combine pure research and practical applications. At the Dominion Astrophysical Observatory at Victoria the chief aim is pure research in Astronomy and Astrophysics, though on occasion it has been possible to make practical applications to assist other services. Operations of both Observatories were authorized by Order in Council P.C. 1726, dated June 30, 1890.

Astronomy of Position

This is a function which is performed by most National Observatories, but by few other agencies. It consists of mapping the positions of the principal stars in terms of right ascension and declination, after much the same fashion as positions of points on the earth are mapped in longitude and latitude. It also includes provision of a time service for Canada, which is one of the most important functions of the Dominion Observatory. Observations for time are made usually on every clear night. Distribution of time is effected daily by radio signals over the C.B.C. network and over station VAA of the Department of Transport, and continuously on lower power over the Observatory station CHU. Time signals are also furnished continuously to the National Research Laboratories, to the Canadian Broadcasting Corporation and to the monitoring station of the Department of Transport, as well as daily to the Canadian National and Canadian Pacific railways for distribution over their lines.

Seismology

Seismographs are maintained at seven places across Canada for the registration of earthquakes and other earth tremors. Besides the study and location of earthquakes and their effects, these investigations yield information, not otherwise available, on the interior structure and composition of the earth. Aside from the above regular program, an investigation is under way into the circumstances surrounding rockbursts in deep hard-rock mines and the possibility of their prediction, with a view to possible saving of life and property. Officers of the Observatory have also kept in touch with methods of seismic prospecting for the location of rock strata and deposits of oil, salt, etc., though no actual work has been done in this direction up to the present.

Terrestrial Magnetism

The three magnetic elements, declination (deviation of the compass), horizontal intensity, and inclination, have been determined at several hundred points throughout Canada, and repeat observations have been made from time to time at many of the points covered. Since all the elements vary progressively with time, it is necessary to determine these secular changes from time to time, so as to be able to provide data for the magnetic maps issued every few years. The aim has been to repeat observations at a selected list of stations every five years, though this aim has not been fully attained.

Magnetic observatories are maintained at Agincourt, Ontario, and Meanook, Alberta, for the continuous registration of the elements. These are essential for the registration of disturbances and diurnal, monthly, and annual variations, necessary for the correction and reduction of field observations; they furnish as well valuable data for the study of the earth's magnetic field as a whole, for collaboration with other institutions elsewhere.

Gravity

The value of gravity has been measured by pendulum observations at some 150 stations in Canada, mainly in the more southern parts of the country. On such observations has been built a theory of the constitution of the earth's crust (the theory of isostasy). When values of gravity have been established, and are interpreted in the light of the geology of the region, indications may be furnished of the presence of oil, salt, or other mineral deposits, and so guide the process of drilling. For the interpolation of the values of gravity between pendulum stations the Observatory in years past made use of the torsion balance. Such surveys have been conducted in Northern Ontario, in Quebec, and in the Maritime Provinces. The development of the gravimeter in recent years has, however, provided a much more expeditious means for this interpolation; gravimeter surveys were carried out in 1944, principally in the Maritimes, and are proposed for 1945 in those provinces and in Quebec.

Astrophysics

Work in this division of the Dominion Observatory has been suspended during the war. Previously programs in both visual and photographic photometry were under way, and these will be revived in the not distant future. This work is entirely research, and is intended as part of Canada's contribution to theoretical astronomy.

Solar Physics

In addition to research problems dealing with solar rotation, solar wave-length, the mechanics of sun-spots, the sun-spot cycle, etc., a good deal of attention has been paid at the Ottawa Observatory to the relations between the 11-year sun-spot cycle and terrestrial phenomena such as temperature, precipitation, tree growths, abundance of animal and insect life, and related subjects. When it is remembered that all animal and plant life depends on radiation from the sun, and that this radiation changes materially with the sun-spot cycle, both in quantity and quality, the importance of such studies is obvious.

Dominion Astrophysical Observatory

The work carried on at this observatory (except for a seismograph station operated for the Dominion Observatory) is largely research, and forms a major portion of Canada's contribution to research in astronomical problems. One of the main lines of work from the founding of the Observatory in 1918 until recently was the determination of the orbits of spectroscopic binaries. In recent years a great deal of work was done on the structure and mechanism of the Galaxy, or Milky Way (our universe), which added considerably to world knowledge on the subject. A considerable problem also undertaken was the deduction of parallax of a selected list of stars by means of studies of their spectra. Still more recently considerable spectro-photometric work has been done.

During the war, work at the Victoria Observatory has been developed along more practical lines to assist in the war effort. One of the developments has been the aluminizing of large mirrors to replace the silvering formerly used. Aluminized surfaces deteriorate very slowly as compared with silvered surfaces, and the efficiency of the great 72-inch telescope has been correspondingly increased.

The aluminizing equipment was used to aluminize mirrors for the Army and Navy; range finders, sextants and binoculars were repaired and adjusted. Sunrise and sunset tables for Victoria were also computed for the Armed Forces.

Instructional lectures on practical astronomy were given to R.C.A.F. officers in training, and on chemical warfare to groups of citizens and municipal officers. One of the staff has acted as Provincial Gas Officer for British Columbia.

Members of the staff were loaned for special war work as follows:—

One to the Geodetic Service for two field seasons; two to the University of British Columbia for one year, each at the request of the National Research Council, and two to the National Research Council where they are still serving.

The work of the Ottawa and Victoria Observatories is purely Dominion, the provinces not entering this field.

WATERS AND WATER POWER

Water Power Development in Canada

The use of the waters of Canada is vital to the economy of the nation in the fields of agriculture, industry, domestic life, navigation, and power. Of these, the field of water-power development is of major importance. Water power is the mainspring of Canadian industrial production both in peace and in war and has enabled the Dominion, with only about one-half of one per cent of the World's population, to attain a position as the third greatest trading nation of the World. From an installed capacity of 173,000 h.p. in 1900 water-power development increased to 8,113,000 h.p. in 1937; to 9,226,000 h.p. in 1942, and to 10,284,000 h.p. at the end of 1944. Approximately 98 per cent of all electricity produced in Canada is generated from water power and the present hydro-power installation represents a capital investment of approximately \$1,871,000,000. The war has demonstrated the strength of Canada as an industrial country. The wide and favourable distribution of water-power resources and the versatility of low-cost hydro-electric power developed from these resources, have been vital factors in making this industrial position possible. In the post-war period, with some 80 per cent of known power sites not yet developed, water power should continue as an outstanding factor in the further development of the other resources of Canada.

To aid and encourage the efficient development of water-power resources throughout the Dominion, the Department of Mines and Resources undertakes the basic and essential work of measuring and recording streamflow from coast to coast, and the collecting of data on potential power sites. It maintains as well, an up-to-date inventory of developed and undeveloped water-power resources. In provincial areas this work is undertaken with the effective co-operation of the provinces.

Dominion Water and Power Bureau

The Dominion Water and Power Bureau which deals with activities in this field was established by Order in Council P.C. No. 47-2885 dated December 16, 1911. Its functions include administration, investigation, the obtaining of basic water data in the field, and its analysis and publication.

The responsibilities of the Bureau are exercised by the head office staff at Ottawa and by district office staffs at Vancouver (sub-office at Kamloops), Calgary, Winnipeg (sub-office at Keewatin, Ont.), Ottawa (sub-offices at Niagara Falls and North Bay, Ont.), Montreal, and Halifax. The Bureau is thus strategically organized to undertake its functions from coast to coast. These functions are described hereunder.

Administrative Functions

The Bureau administers the Dominion Water Power Act, the Irrigation Act and the Reclamation Act and matters arising out of the Lac Seul Conservation Act, 1928, the Lake of the Woods Convention with the United States dated February 24, 1925, and the Boundary Waters Treaty of 1909, the responsibilities under the last named being more particularly referred to hereafter under the heading "Advisory Functions". The Bureau administers hydrometric surveys throughout the Dominion, those in each of the provinces being undertaken by means of co-operative agreements with the provincial governments under authority of the Dominion Water Power Act. These responsibilities are more fully referred to hereafter under the heading "Investigatory Functions".

Advisory Functions

The Bureau acts in an advisory capacity to the Department of External Affairs and the International Joint Commission with respect to international water problems and, through representation on international boards, is administratively responsible for the apportionment, regulation, and control of international waters under treaty commitment, and orders of the International Joint Commission. The boards on which officials of the Bureau act as Canadian representatives are as follows:—

International Columbia River Board of Control
International Columbia River Engineering Board
International Kootenay Lake Board of Control
International Osoyoos Lake (Okanagan River)

Board of Control

International St. Mary and Milk Rivers Board of Control

International Souris River Board of Control
International Lake of the Woods Board of Control
Canadian Lake of the Woods Control Board
International Rainy Lake Board of Control
International Prairie Portage Board of Control
International Lake Superior Board of Control
International Niagara Board of Control

Special International Niagara Board

International Massena (St. Lawrence River) Board of Control

International Lake Champlain Board of Control
International Lake Memphremagog Board
International St. Croix River Board of Control

The function of these boards is to administer the regulation of flow, and the use of the above international waters.

In addition, an official of the Bureau acts as consultant to the Canadian Temporary Great Lakes-St. Lawrence Committee.

The Bureau collaborates with the International Joint Commission in the carrying out of the responsibilities imposed upon the Commission by the Governments of Canada and the United States, acts in an advisory capacity to the Dominion Bureau of Statistics in the annual census of the Central Electric Station Industry in Canada, and collaborates with other services and branches of the Department of Mines and Resources, and with other Dominion departments, in the solution of problems related to water resources.

Investigatory Functions

The investigatory functions of the Bureau include the investigation, analysis and recording of the water and power resources of Canada in their dominion and international, and (in co-operation with the provinces) in their provincial and interprovincial aspects; the promotion of water conservation and power development in relation to the use of other natural resources, including irrigation, drainage, flood control, industrial and domestic needs, and the improvement of navigation; the exchange and supplying of information on water resources by means of published reports and otherwise.

The field activities are based upon and centre around co-operative agreements which have been entered into between the Dominion and the provinces and which provide for the co-operative investigation of water resources from coast to coast. Under these co-operative agreements the Dominion undertakes the fundamental work of operating a hydrometric survey throughout Canada providing the necessary engineering and office staff and field and office equipment; the provinces contributing funds and services, annually, in amounts related to the work undertaken primarily of provincial interest. In this way all basic water resources investigations are carried out on a watershed basis without regard to interprovincial boundaries, complete uniformity and standardization is achieved in the location and equipment of stream measurement stations, and in the field and office methods of measurement, computation and compilation. The final records are published on a watershed basis and are made available to the various Dominion and provincial governmental administrative departments and to municipal and private corporations throughout Canada. All who are interested are thus enabled to analyze and utilize the water resources data with confidence in its dependability and its uniformity in all provinces. In addition to the hydrometric work carried on by the Dominion under the Dominion-Provincial agreements, the provinces themselves undertake a great deal of work in connection with the development of their water resources. This work includes special investigations of power sites, diversions of water from one watershed to another where it would be more useful, water storage projects for power development, irrigation, and domestic water supply, flood control works, works for the control of water for irrigation and other uses. The fundamental water resources data secured by the Dominion, and the results of the detailed water or power investigations made by the provinces, are mutually exchanged on request. As a result of this co-ordinated effort the investigation and analysis of Dominion and provincial water resources have been carried on for the past twenty-five years or more with no duplication in work or expenditure by the Dominion or the provinces.

and with the most effective economy. Contributions in funds by the provinces towards the work are presently on the basis of \$35,570 per annum.

In the field of purely Dominion responsibility the Bureau undertakes water resources investigations in the Yukon and Northwest Territories, on Indian Reserves and Dominion lands, on international waters and waterways along the boundary between Canada and the United States, and Canada and Alaska, and on navigable waters. Direct co-operation is maintained with the various Dominion departments interested in run-off data and the solution of water problems. This includes co-operation with the Department of Public Works in the securing of records necessary for navigation; co-operation with the Dominion Department of Agriculture in the maintenance and operation of numerous gauging stations in the drouth area of the Prairie Provinces to provide the hydrometric data required in the administration of the Prairie Farm Rehabilitation Act; co-operation with the Departments of Fisheries, National Defence, National Health and Welfare, and with other branches and services of the Department of Mines and Resources in all problems dealing with the use of water.

The Bureau maintains an up-to-date inventory of the developed and undeveloped water-power resources of Canada and prepares and issues annual statements and periodical press articles dealing with these resources. The maintenance of this inventory is effected by close collaboration with the provinces through the instrumentality of the co-operative agreements already mentioned.

ENGINEERING AND CONSTRUCTION

The Engineering and Construction Service which is responsible in this field of activity operates under the authority of the Act establishing the Department of Mines and Resources. It provides engineering and architectural advice, undertakes necessary inspections and surveys, supplies reports, estimates, plans, specifications, and supervises construction operations on engineering and architectural projects for the Department of Mines and Resources. It also gives engineering advice on highway projects throughout Canada to which the Dominion may contribute and administers the contributions in the Dominion interest.

The architectural work embraces the examination of building sites, the preparation of designs, detailed drawings, specifications, preparing calls for tenders, contract documents, progress estimates, etcetera, for new structures of various types such as residential and day schools, agents' residences, hospitals, warehouses, storehouses, teachers' residences, principals' residences, bathhouses, administration buildings, fire-halls, staff residences, recreational buildings, fish hatcheries and related structures in connection with Indian Affairs and National Parks projects. It also embraces inspections and detailed reports on structural and mechanical matters associated with the maintenance of buildings operated by the Department.

The engineering work embraces the making of extensive field surveys and the preparation of estimates, plans, profiles and detailed drawings in connection with highway work, bridge work, protection works, wharves, water, sewer, power plants and other municipal services in National Parks and Indian Reserves; also highway work in the Yukon and Northwest Territories. The work also embraces the letting of contracts and the

supervision of the work during construction operations both by contract and day labour. It also embraces inspections and detailed reports on existing structures and services.

The Engineering and Construction Service undertakes work of a special nature, as illustrated by the following:

For the Department of National Defence for Air, field location surveys were made and plans, profiles, specifications and contract documents were prepared for highway work in Newfoundland.

On the recommendation of the War Committee of the Cabinet, necessary surveys were made, contract documents prepared and construction supervised for 112 miles of highway for national defence purposes extending from the vicinity of Prince Rupert to a point opposite Kitwanga, British Columbia. The total cost of this project, which was entirely a Dominion project, was \$11,069,054.

At the request of the Department of Labour, highway work camps were operated for Alternative Service Workers in the provinces of Ontario and Saskatchewan.

At the request of the Department of Labour, highway work camps for the employment of Japanese evacuated from the restricted areas of the Pacific Coast were established and operated in the provinces of Ontario, Alberta and British Columbia.

Under authority of an Order in Council, two inspecting engineers are located on the Alaska Military Highway acting as observers in the interest of the Dominion while the United States authorities are responsible for this highway.

While the various provinces are wholly responsible for engineering work in connection with their provincial activities, the Engineering and Construction Service from time to time supervises or undertakes projects in provincial areas at the request of provincial Governments or under authority of special agreements. Such projects are usually those to which the Dominion contributes and which have a special Dominion interest. There is no duplication of work or conflict of authority whatever in connection with such undertakings.

Among them is the development of highways in provincial areas and in which the Dominion has an interest from the national standpoint. Such highway work is undertaken on a joint basis by the Dominion and the province. The Engineering and Construction Service reviews joint programs suggested by the provinces and when these are approved inspects and checks construction operations and administers the payment of the Dominion funds. The individual agreements covering these activities are approved by the Governor in Council and the Dominion's share is financed by Parliamentary vote.

For the years 1936-41 Dominion assistance to the extent of \$17,000,000 was given through the Engineering and Construction Service of the Surveys and Engineering Branch towards the development of main and tourist highways in provincial areas.

GEODETIC SURVEYS

The Geodetic Service undertakes basic surveys of the highest order of accuracy for the control of mapping and of all other types of survey throughout the entire country.

It provides horizontal control by means of nets of first order triangulation, precise traverse, and astronomical observations. Vertical control is provided by nets

of precise levelling along carefully selected lines across Canada. These lines as a rule are along railways, trunk highways, or where such are not available, along water routes in winter. These nets give fundamental information as to elevations upon which the levelling required in connection with any other surveys, mapping, or construction operations can be based. Up to the end of March, 1945, geodetic levelling nets included 44,414 miles of levelling and 17,005 benchmarks.

The Geodetic Service was commenced in 1905 and the organization was authorized by Order in Council P.C. 766; dated April 20, 1909. This Order in Council states that "the object of geodetic survey work is to determine with the highest possible accuracy the positions (and elevations) of points throughout the country—which may form the basis of surveys for all purposes, topographic, engineering or cadastral and thereby assist in the survey work carried on by other departments of the Dominion Government, by the provincial governments and by municipalities, private persons and corporations."

During the war the Geodetic Service supplied survey data for Canada and Newfoundland for use in the preparation of maps for the R.C.A.F. Special surveys for defence purposes were made at Sydney, Halifax, and Saint John. Special investigations of the determination of the co-efficient of refraction under various conditions, for use with depression type range finders of coastal batteries were made at Halifax, N.S., and Victoria, B.C. Suggestions and specifications for an important range finding instrument being designed by the National Research Council, were supplied to the National Defence Department and special technical investigations relative to range finding of targets for coastal defence were also made.

Instruments were loaned to Research Enterprises Limited, and the lengths of a number of lines at Leaside and Scarboro were determined, for the testing of equipment being constructed for war purposes.

The geographical positions of a number of points in Nova Scotia, Newfoundland, and Labrador were determined by astronomical observations of the highest order of accuracy, at the request of the Royal Canadian Navy and the United States Navy, in connection with operations of a secret nature.

The detailed activities of the Geodetic Service are as follows:

Triangulation

Triangulation, and occasionally precise traverse, is laid down in chains or belts at intervals 50 to 200 miles apart with a high degree of accuracy, and the precise geographic positions of numerous permanently marked stations are secured, together with the lengths and directions of lines. Local surveys can be tied to, or based on, these triangulation nets, checking their accuracy, revealing errors, preventing overlaps and discrepancies, obviating many land boundary troubles and, in general, contributing vitally to the economy of survey work in all sections of the country and by all organizations interested in mapping, charting, and engineering operations of all kinds.

A large series of publications has been issued detailing triangulation data in all parts of Canada.

During the present year triangulation operations are being carried on in the area between the North Shore of the Gulf of St. Lawrence and the Labrador boundary, between Edmonton and Jasper, Alta., and eastward from Whitehorse along the Alaska Military Highway.

Astronomical Observations

In areas not yet covered by accurate triangulation, such as northern Canada, where maps of large areas are required for flying and prospective development, aerial photographs are used to map the country. Here astronomical methods are employed by the Geodetic Service to supply control points on which to base such aerial mapping. At intervals of 50 to 75 miles small parties take astronomical observations for latitude and longitude. These points are pin-pointed on the aerial photographs and serve a vital purpose for small scale mapping, just as triangulation does in more highly developed areas where more accurate surveys are called for.

Levelling

Geodetic levelling has been carried along many of the railways of Canada so as to form a series of nets extending from coast to coast. The high standards of precision maintained may be judged by the fact that on precise levels across Canada the discrepancy between Atlantic and Pacific Ocean mean sea levels was less than one foot. Supplementing the lines along railways where considered desirable, levels have been run along trunk highways. At the present time such work is being done on the Big Bend Highway between Golden and Revelstoke in connection with the investigation of the water and power resources of the Columbia River Basin being made for the International Joint Commission. Similar work was done in 1944, and is being continued this year, on the Alaska Military Highway between Dawson Creek, B.C. and Whitehorse, Y.T., to provide vertical control for any development that may take place in the area adjacent to that road. During the present year precise levelling is also being carried along the railway lines of Prince Edward Island at the request of the government of that Province.

The datum used by the Geodetic Service is mean sea level, and this datum was authorized by Order in Council P.C. 630, March 11, 1935, to be the official level datum for Canada.

The use made of these lines of control levels is tremendously widespread. A large series of publications is required to supply permanent precise information. In addition another series of publications is available whereby approximate elevations are made available through a co-ordination of a mass of information supplied by country-wide agencies of all kinds.

Isostasy and the Deflection of the Vertical

A program of the determination of the latitude and longitude by astronomical observations of the highest order of accuracy is being carried on. At a large number of points being observed those values are also available from geodetic triangulation. The astronomical results combined with the geodetic values give the deflections of the plumb line from the vertical, and also provide data for the continuation of research into the shape of the geoid and its dimensions. Such data are also of value in developing the theory of the constitution of the earth's crust known as isostasy.

Miscellaneous

In addition, but related, to the regular operations of the Geodetic Service many special investigations are undertaken in which the high qualifications of geodetic officers have been made available to solve problems of peace and war. As examples of these are one relating to the design of special theodolites, investigation of refraction conditions on the Pacific Coast in relation to range finding for artillery, aerial navigation in polar regions, problems in connection with size, shape and density of the earth's crust, a special problem for the benefit of Prince Edward Island surveying requirements, and many others.

The work of the Geodetic Service is entirely Dominion, the provinces not entering this primary field.

THE INTERNATIONAL BOUNDARY COMMISSION

The function of the International Boundary Commission is the demarcation and maintenance of the boundary between Canada and the United States including the Alaska boundary. This boundary has a total length of 5,527 miles of which 1,540 miles are adjacent to Alaska and the remaining 3,987 miles form the main boundary from Passamaquoddy Bay to the Pacific Ocean. In this latter part 1,789 miles are land boundary and 2,198 miles are water boundary. As surveyed and marked the boundary is a series of straight lines regardless of the curvature of waterways, watersheds or parallels. In the waterways the straight lines join turning points which are controlled by reference monuments on the adjacent shores and on the land there is a monument at each change of direction. Altogether the boundary line is marked by 7,990 monuments of various types.

The Boundary Commission functions under the authority of conventions or treaties with the United States of 1903, 1906, 1908 and 1925. While previous agreements dealt only with specific sections of the boundary, the treaty of 1908 provided for the survey and demarcation of the whole line from Passamaquoddy Bay to the Pacific Ocean. This treaty provided also for the designation of one commissioner by each government to carry out the provisions of the treaty. While the personnel of the Commission has been changed by death or resignation, all the work at any one time was under the unified direction of the same commissioners, with the exception of the St. Lawrence River and Great Lakes Section which was assigned to the International Waterways Commission. This Section has since come under the Boundary Commission.

The Boundary Commission is divided into a Canadian and a United States Section each section consisting of the respective commissioner and his staff of engineers, draftsmen, etc. Article IV of the treaty of 1925, which provides for the maintenance of the boundary in a state of effective demarcation, stipulates that each government shall pay the salaries and travelling expenses of its own commissioner and his assistants, but that the expenses jointly incurred by the Commissioners in maintaining the demarcation of the boundary line in accordance with the provisions of the treaty shall be borne equally by the two Governments. The treaty of 1925 also provides for the appointment by either Government of a new commissioner in the case of the death or resignation of its present Commissioner; and

that Article IV may be terminated upon twelve months written notice given by either Contracting Party to the other.

On account of its international character and because it is authorized by joint agreements between the governments of Canada and the United States, the International Boundary Commission is a purely Federal activity. The work of the Commission is a treaty obligation and does not duplicate or overlap any provincial activity of any kind.

HYDROGRAPHIC SURVEYS

These are the responsibilities and activities of the Hydrographic Service and are purely Federal functions relating to navigation and shipping by virtue of Sub-section 10 of Section 91 of the British North America Act and they do not overlap or duplicate Provincial functions or activities. They comprise the following:—

Conducting hydrographic surveys of the coasts and tidal waters of Canada, including the harbours and approaches and the bays, inlets, estuaries and navigable rivers to the heads of navigation of the latter, (a) on the Atlantic, from the International Boundary in the Bay of Fundy to the Labrador Boundary at Belle Isle strait, (b) on the Pacific Coast from Juan de Fuca strait to the Alaska Boundary, including the Queen Charlotte islands, (c) Eastern and Western Arctic, including Hudson bay and strait; and similar hydrographic surveys of the St. Lawrence river and Great lakes and their connecting waterways, and the inland lakes and rivers;

Conducting, sounding and sweeping surveys of all these waters for the locating and examination of underwater dangers to navigation; and assisting other Federal Government marine services in the establishment of floating aids to navigation;

Producing and printing from these surveys and other related data, standard nautical or mariner's charts, of both coastal and inland waters and harbours, and maintaining and distributing these to the Naval and Merchant services, and transportation interests; and compiling and publishing special radio direction-finding charts, magnetic charts, water current and temperature charts;

Preparing, writing, editing and publishing volumes of Coast Pilots and Sailing Directions supplementing the information on navigation charts, of the Canadian coasts, lakes, rivers, harbours and waterways;

Conducting oceanographical surveys of Canada's in-shore and offshore tidal waters for naval and coastal defence purposes, fishery biological research and other scientific purposes;

Maintaining the national system of tide recording stations and conducting current surveys in tidal waters and preparing and publishing the standard tide tables for Canadian ports and harbours and publishing reports on tidal current actions;

Measuring and recording the water levels of the Great Lakes and St. Lawrence river systems and providing compiled data and reports for navigational, scientific and engineering purposes;

Conducting special surveys and examinations of the seaward approaches to ports and harbours for the installation of underwater naval and military defence apparatus, and preparing secret and intelligence charts and plans for the Naval Service for use in protection of coasts, harbours and convoy routes, and the detection of enemy war vessels.

Generally, the work of the Hydrographic Service has as its objective the protection of shipping of all kinds in Canadian waters and the development of Canada's water routes.

LEGAL SURVEYS AND MAP SERVICE

The activities of this Service fall under two main headings:

- (a) Legal Surveys
- (b) Map Service

Legal Surveys

The work of this division comprises all legal surveys required by the Department of Mines and Resources, including the Northwest and Yukon Territories, National Parks, Ordnance Lands, and Indian Reserves, and the legal surveys required by other Government Departments.

Such work is undertaken by qualified surveyors acting under instructions of the Surveyor General of Dominion Lands, who is executive head of the Service. Surveyors employed in Dominion areas must hold Commissions as Dominion Land Surveyors and those employed in the provinces must be qualified as Provincial Land Surveyors of the province in which the work is undertaken.

To obtain and provide Dominion Land Surveyors an official Board of Examiners is appointed and maintained by the Dominion through statutory authority to administer the training and examination of applicants for both preliminary and final Dominion Land Surveyor certificates.

The work of the Legal Surveys Division is undertaken with statutory authority and the scope of activities of the Dominion and the provinces in regard to legal surveys is clearly defined by Dominion and Provincial Acts. There is consequently no possibility of duplication or overlapping.

Map Service

The work of this division is generally as follows:

To maintain the central office for indexing, filing and recording survey returns and plans of the Surveys and Engineering Branch and supplying information from them; to compile and prepare electoral maps, general maps for use of various Government Departments, air navigation charts, natural resource and railway maps, general maps of Canada, and other types of maps; to print such maps; to distribute maps as required.

The maps may be divided into two categories. The first includes general maps depicting the whole Dominion or undertaken to meet departmental or administrative needs of the Federal Government. The following are examples.

General Maps

- Map of the World showing Trade Routes
- North Pacific and North Atlantic Aeronautical Maps
- Railway Map of Canada—100 miles to one inch
- Natural Resource Map of Canada
- Magnetic Map of Canada
- Railway Map of Canada—60 miles to one inch
- Map of Northwest Territories
- Wall Map of Canada—35 miles to one inch

Departmental Maps

Maps of all National Parks (For Department of Mines and Resources)

Canada's Eastern Arctic (For Department of Mines and Resources)

Canada—Radio Stations (For Department of Transport)

Daily Weather Map of Canada (For Meteorological Service)

Orographical Map (For Canada Year Book)

Dominion Electoral Maps (For Chief Electoral Officer)

The above classes of maps are of a federal or general nature and the provinces do not enter into this field. There is consequently no duplication or overlapping.

The second category includes maps which form part of standard series designed to eventually cover all of Canada irrespective of provincial boundaries. These maps are National in character and the Dominion requires them for the orderly development of the nation's trade and resources. One or two series of maps are of an international character. The following are examples of the second category:

National Topographical Series: (This is a compiled series at different scales for national purposes from the best sources available)

International Aeronautical Series (air navigation)

Sectional Maps of Western Canada

International Map of the World, scale 1 to 1,000,000

The larger scale maps in this category are different from such maps as may be issued by the provinces because they are all to one standard design and they constitute base maps showing features of general utility for all purposes. They fit accurately together and will thus eventually cover the whole country.

Maps as issued by the provinces are confined to their provincial boundaries and in general are issued for purposes of a provincial nature to show administrative districts, provincial or electoral districts, etcetera. The closest co-operation has been maintained between the Map Service and the survey organizations of the various provinces to insure that there will be no overlapping of field or office work.

Most of the base maps have been made by the Dominion and provincial maps have been produced from these. For example the new catalogue of the Dominion Map Service will show about 1,800 geographical or topographical maps available for distribution while the number of similar maps available for distribution from all the provinces is in the neighbourhood of 140.

Generally the provinces do not carry on mapping survey work or produce their own topographical maps with the exception of British Columbia where, due to the special need for topographic maps, a small but efficient mapping service has been organized for some years.

Preparation of Maps

The Map Service issues completed maps ranging from black line prints to highly processed maps of seven or nine colours. The equipment used for complete map reproduction includes drafting and plotting appliances, photo-mechanical equipment, lithographic equipment and printing presses.

A great amount of work has been undertaken by the Map Service in connection with Canada's war effort, particularly in the issue of the Air Navigation Charts and special maps for the use of the Armed Services.

The following is a statement of maps published in 1943-44:

New maps printed.....	132	Total copies	252,900
Maps reproduced.....	59	" "	69,200
Maps revised.....	20	" "	77,700
Reprints	215	" "	1,010,400
Hydrographic charts and miscellaneous jobs.....	160	" "	118,800
	586		1,529,000

6. INDIAN AFFAIRS

Under the British North America Act Indians and the lands of Indians are the direct and sole responsibility of the Dominion Government. The administration is carried out under the provisions of the Indian Act. The Indian population at the present time is approximately 129,000. The three main features of the administration are the education, health, and welfare of the Indians. In actual practice this means that the schools necessary for the education of the Indians, hospitals for their medical care and buildings and structures required for administrative purposes are wholly provided by parliamentary appropriation. In the administration of Indian affairs, however, co-operation between provincial governments and the Dominion has always been and still is in evidence.

WELFARE AND TRAINING

Training

There are, at present, 76 Residential Schools and 255 Day Schools, as well as 6 combined White and Indian Schools in operation. In each of the provinces Indian schools adopt the provincial curriculum and are inspected by provincial school inspectors. Indian children enrolled in these schools at present number 16,438.

Indian children who qualify for special grants to pursue high school studies attend high schools administered by provincial departments of Education, and secure their academic standing from these departments.

Welfare

The Welfare administration attends to the purchase and distribution of supplies to needy and physically incapacitated Indians, the purchase of farm machinery, livestock, construction and repair of Indian homes, purchase and distribution of supplies in conformity with Treaty obligations, the organization of an extension program (short courses, lectures, etc.) in a limited number of cases in co-operation with provincial departments of Agriculture and the general betterment of living conditions on Indian Reserves. The administration of family allowances in the case of Indians is now under the direction of this division.

ADMINISTRATION

There are, at this date, 100 Indian Agencies in Canada administering over 3,000 Indian Reserves. These agencies, in each case, are under the direct supervision of a Dominion official known as the Indian Agent. In all the provinces, with the exception of Nova Scotia, New Brunswick, and Prince Edward Island, Inspectors

exercise supervisory powers and are responsible, under departmental authority, for the direction of Indian administration.

Funds for the construction, maintenance and repair of administration buildings are provided by Parliament each year. Moneys are also provided by Parliament each year for the construction, maintenance and repair of roads and bridges on Indian Reserves, and for other improvements such as water supply and irrigation systems, fencing, drainage of lands, breakwaters and many other improvements.

Where band funds permit some of the latter mentioned improvements are paid for from Indian Trust Funds, or Indian Trust Funds and parliamentary appropriation may both be used.

In some instances road work has been undertaken in co-operation with provincial governments, and lands have been surrendered to the provinces for road purposes where required. In other cases assistance from the province has been given by way of subsidies. In a few cases provincial governments have constructed highways through Indian Reserves without securing title to the land, but in the main the roads on Indian Reserves are maintained by the branch with funds provided by Parliament or Indian Band Funds.

MEDICAL SERVICES

While there is no direct responsibility under the Indian Act it has been the practice, for a number of years, for the government to provide free medical and hospital facilities for indigent Indians.

At present the department maintains and operates fifteen Departmental hospitals with a total capacity of 500 beds, and is in process of taking over and opening three other hospitals with a combined capacity of 350 beds. Plans for the provision of another 700 beds are under consideration.

Thirty-five full time medical officers are employed and it is contemplated that this number will be materially increased. Free medical care is provided by arrangements for part time services of approximately 450 physicians, and in many instances the revenue from the Indian work is responsible for keeping a doctor in an area where he would not otherwise have a remunerative practice.

The department employs twelve full time nurses in field work as well as the field work done by the nurses attached to our various institutions. Arrangements are also made so that the part time services of either a fully qualified or partially trained nurse are available on almost every Indian Reserve. In most cases this constitutes part time arrangements with provincially employed nurses or with nurses doing private duty in the area.

Certain hospitals are operated under arrangements with provincial organizations and in some instances medical officers are joint employees of both the province and Indian Affairs.

In the field of tuberculosis practically all services are conducted by arrangements made with provincial tuberculosis organizations, and there has been an advisory committee established for the control and prevention of tuberculosis among Indians, the membership of which is largely composed of provincial tuberculosis control officers.

The Department does not own or operate any mental institutions. Insane Indians are cared for in provincial institutions.

Where the Department does not operate its own hospitals, Indians are admitted to the most conveniently located local institution. A large number of Indians receive tuberculosis treatment in provincial institutions. In all such cases the Department pays a per diem rate.

DEVELOPMENT OF NATURAL RESOURCES

Indian lands in Canada approximate five and one-half million acres. It is estimated that over one-half of this acreage is well timbered and well watered. Indian lands embrace areas believed to be well mineralized and many extensive areas embrace potential oil-bearing possibilities. In short all the basic resources of Canada may be found on the Indians' land heritage and their development, conservation and full utilization in the promotion of Indian welfare is a direct federal responsibility.

This administration, however, possesses only rudimentary information as to the extent and nature of these resources and a complete and accurate survey of Reserve lands across Canada, involving classification of lands, appraisal of forest stands, examination and study of water power possibilities, geological studies and surveys, and appraisal of their potential as fur, game and fish producing areas, is an urgent and immediate need.

Indian Lands

The total area of Indian Lands, however, is not sufficiently extensive to warrant the employment by the administration of a staff of experts in every branch and a possible solution to the problem might well be closer co-operation with the provinces in which the Reserves lie and the securing of the services of the trained staffs already set up in each province to furnish the Department with the technical information necessary to plan development of the resources which Reserve lands represent.

Specifically with reference to lands, provincial Departments of Agriculture in most instances maintain trained staff capable of giving valued advice and direction on the fuller development of Indian land resources in the interest of the Indian owners. Provincial engineering staff could give valuable advice with reference to road location and construction, and local drainage problems. Internal surveys most urgently required on most Reserves might be done more economically in close co-operation with provincial departments.

Forests

Indian forest resources, while substantial, are scattered throughout all of the nine Provinces and the Northwest Territories and of necessity in scattered stands. The proper management of these resources involves volumetric survey, classification, appraisal and the study of local demand for the forest products. It further involves some adequate provision for fire prevention and suppression, control of insect infestation and the spread of bacterial disease. The volume of these lands is not sufficiently great to economically maintain a staff of experts whose effort would be spread over such great distances or the installation of adequate protective

equipment and staff to take care of the asset in its widely scattered situation. In aggregate in each province Indian timbered land is a very small percentage of provincial holdings, yet, if neglected, these small stands can and do endanger the whole. It would, therefore, appear to be in the mutual interest of both the province and the Indian Administration that some co-operative arrangement that is equitable and fair to both parties should be worked out with the provinces with respect to Indian timber. At the present time, timber regulations vary widely among the provinces, yet the Administration is compelled to embrace the whole field in one set of regulations with little regard to local considerations and conditions. It may, therefore, be that the adoption of provincial regulations in each province as applicable to timber on Indian Reserves in so far as practicable and the administrative machinery set up by the provinces on a co-operative cost-sharing basis might be of advantage.

Water Power

There are many instances throughout Canada where potential power sites are actually located within the boundaries of Indian Reserves, the importance of which extend far beyond the Reserves in which they are located. It is obvious that the development of such sites is a matter of greater importance to the district in which they lie than to the Reserve itself, and federal co-operation with the provinces is essential for their development.

Mining

The mineral wealth lying beneath the surface on Indian Reserves is virtually unknown and the volume of such lands under the direct administrative control of the federal government is not such as would warrant the setting up of a special organization of technical experts to appraise and develop it. It is clearly a field in which the services of provincial organizations on some satisfactory basis might be enlisted, and, as in forestry, the provincial regulations and administrative machinery adopted in so far as practicable. This is particularly true of oil-bearing structures where the whole field, rather than a part of it which happens to lie on an Indian Reserve, must be considered, indicating the necessity for the close co-ordination with the provinces of both regulations and administrative functions.

Fur

The fur potential on Indian Reserves in Canada is almost negligible as the planned management of fur, due to its mobility, must cover very extensive areas, of which the total areas on Indian Reserves would form a very small fraction. On the other hand, possibly fifty thousand of Canada's Indians subsist almost wholly by the trapline and on resources and over lands provincially owned and controlled. Development, therefore, of the fur resources in the interest of the Indians can only be achieved by provincial effort with the Dominion contributing substantial financial assistance. The welfare of the Indian trapping population is so completely bound up in the development of fur, fish and game resources that the necessity for assistance to the province from the Dominion Treasury cannot be too strongly emphasized.

PART II

OTHER PUBLIC PROJECTS¹

1. FOREWORD

This reference material was compiled by the Sub-Committee on Public Projects of which H. W. Lea was Chairman and O. J. Firestone, Secretary.

The terms of reference of this Sub-Committee requested the preparation of descriptive, factual material giving a picture of the existing division of responsibilities between the Dominion and provincial governments in the following fields:

- (a) Harbours, docks and wharves;
- (b) Airports and civil aviation facilities;
- (c) Railways;
- (d) Highways and bridges;
- (e) Hospitals and other health facilities of a capital nature.

2. DIVISION OF RESPONSIBILITIES

Public investment in Canada has been related closely to the stage of economic advancement, the distribution and growth of her population, the area and physiography of the country, the type and distribution of natural resources, the constitutional division of administrative responsibility and the fiscal position of the various levels of governments.

In accordance with the Canadian constitution and principles of divided jurisdiction developed since Confederation, expenditures on public investment projects are made by three levels of government—Dominion, provincial and municipal. In the public works field, the Dominion Government is concerned with projects of a national or international nature and certain undertakings specifically made a federal responsibility in the British North America Act, e.g., shipping, railways, canals, telegraphs.² Provincial governments look after local works and undertakings, except projects of an inter-provincial nature. In practice, provincial governments are responsible for a substantial section of the transportation system (mainly highways), electric power development (hydro), certain public buildings and institutions (hospitals, orphanages, etc.), and certain public utilities (e.g., provincially operated telephone systems).³ The municipalities and other organized units (counties, improvement districts, etc.), which are under the jurisdiction of the province, are concerned with the construction and maintenance of public facilities within their territory, e.g., streets and sidewalks, municipal buildings and grounds and public utilities (sewers, waterworks, gas and electricity).

The division of responsibilities and activities between the Dominion and provincial governments in the public

projects fields is discussed in detail in the succeeding text, followed by a quantitative appraisal of the role which various types of construction projects have played in Dominion, provincial and municipal public investment activity.

3. TRANSPORTATION PROJECTS

HARBOURS, DOCKS AND WHARVES

Under the British North America Act,¹ such works as harbours, docks, wharves and other river and lake improvements were placed under the control of the federal authority. Under Section 91 (10) of the Act, navigation and shipping were included in the legislative powers of the Parliament of Canada and by Section 108 the provincial public works enumerated in the Third Schedule became the property of Canada. Among the works so enumerated were public harbours, piers, and rivers and lake improvements.

Harbours may be classified generally as follows:

1. Under federal jurisdiction
 - i. National harbours—under the control and administration of the National Harbours Board under the Minister of the Department of Transport. This Board administers eight harbours as well as two terminal grain elevators and carries out all construction work required.²
 - ii. Commission harbours—administered by local harbour commissioners under the Department of Transport (Marine Services).
 - iii. Public harbours—under the jurisdiction of the Department of Transport (Marine Services).
2. Under provincial jurisdiction—Public harbours.
3. Under municipal or other control—Private harbours.

The Dominion Department of Public Works (Engineering Branch) is responsible for the construction of wharves, piers, breakwaters, dams, etc., throughout Canada, except in the harbours that come under the jurisdiction of the National Harbours Board. Once the wharves and piers have been constructed by the Department of Public Works they are administered by the Department of Transport. Small items of repair are paid for by the latter department with revenues collected in the course of administration. Large repairs are the responsibility of the Department of Public Works. The Department of Public Works is also responsible for the improvement of harbours and rivers by dredging (except dredging done by the Department of Transport in the St. Lawrence River Ship Channel) and for the construction, operation and maintenance of graving docks.

AIRPORTS AND CIVIL AVIATION FACILITIES

At the time of Confederation, flying was not a means of transportation and there is no mention of aviation in the British North America Act. By 1919, however, air

¹ For a detailed quantitative appraisal of Dominion, provincial and municipal projects of all kinds see *Public Investment and Capital Formation, a Study of Public and Private Investment Outlay, Canada 1926-1941*, Dominion-Provincial Conference on Reconstruction.

² The B.N.A. Act, 1867, 30 Vic., Chap. 3, Section 92 (10).

³ The B.N.A. Act provides that local works and undertakings, although wholly situated within a province can be declared by Parliament to come under Dominion jurisdiction, if such procedure is "to the general Advantage of Canada or for the Advantage of Two or more of the provinces." B.N.A. Act, 1867, 30 Vic., Chap. 3, Section 92 (10).

¹ B.N.A. Act 1867, 30 Vic., Chap. 3.

² Harbours at St. John, Halifax, Quebec, Three Rivers, Montreal, Chicoutimi, Vancouver, and Churchill, Man., and grain elevators at Prescott and Port Colborne, Ont.

transport was recognized as an important factor in the development of Canada's natural resources and, under the Aeronautics Act¹ of that year, the Dominion Government was given control over civil aviation in Canada. Federal jurisdiction in the field of aviation was later questioned but was upheld by a ruling of the Privy Council.

The Department of National Defence for Air has control, in general, of airports, landing fields and associated facilities used for military purposes. Exceptions exist in the cases of certain airports which are administered by the Department of Transport while being used by the Royal Canadian Air Force. Civil aviation is under the administration of the Department of Transport. The Civil Aviation Division of that department is responsible for construction and maintenance of all facilities at Government-owned civil airports and intermediate airports. This includes aircraft operational areas, buildings, lighting and telephone services. The Division is responsible also for development of radio range sites and construction of buildings; the Radio Division of the same Department installs the radio equipment and operates the ranges. In the B.C.A.T.P. the Civil Aviation Division was assigned the responsibility for selection and development of airports and the lighting, telephone, water and sewerage services required in connection therewith. Buildings were constructed by the Department of National Defence for Air. The Department of Transport also assists municipalities in designing and constructing municipal airports. During the war, this Department leased the larger municipal airports on the main line airways system for inclusion in the B.C.A.T.P. and improved the facilities thereon as required by the R.C.A.F.

The provinces have been interested in aviation for the development and protection of natural resources, and in some provinces, air services have been established for forest fire protection and exploratory operations. The municipalities have built airfields to encourage and attract business by the development of more rapid means of communication. In all cases, the construction of airports and aviation facilities has to conform to regulations set out by the Dominion Government before an operating licence is granted. The Civil Aviation Division of the Department of Transport acts in an advisory capacity in all matters pertaining to the construction of municipal or provincial airports. In general the cost is borne by the municipality or province, but exceptions to this rule have been made where the federal assistance has been given as being in the national interest.

RAILWAYS

Jurisdiction over railways, with the exception of those located entirely within a province, lies with the Dominion Government. Under Section 92 (10a) of the British North America Act, railways connecting one province with another or others, or extending beyond the limits of a province, were excepted from the exclusive powers of the provincial legislatures, and by the Third Schedule mentioned in Section 108, all railways and railway stocks, mortgages and other debts due by railway companies which had formerly been under the control of any of the provinces were transferred to the federal authority. Under Section 145, the completion

of the Intercolonial Railway was made a Dominion responsibility. The absorption of provincial lines into the two great national systems has left very few steam railways outside the jurisdiction of the Dominion Government.

Control over all railways within the legislative jurisdiction of the Dominion of Canada lies with the Board of Transport Commissioners (formerly the Board of Railway Commissioners) which has very wide powers for making rules and regulations governing the construction, operation and management of railways and the approval of freight, express and passenger tariffs. The approval of the Board must be secured for all farm, highway and railway crossings, junctions, spurs, bridges, wharves, tunnels, telegraph and telephone lines constructed by a railway company. In the matter of grade crossings, the Board has the power to allocate costs between the municipality or locality in which the crossing is situated, the railway company and the Board itself, which has a fund for this purpose. The Board also has jurisdiction over electric railways, which have been declared to be for the general advantage of Canada, such as the Montreal and Southern Counties Railway in Quebec, which is Dominion incorporated and is operated by the Canadian National Railways, or the Grand River Railway in Ontario which is operated by Canadian Pacific Railway Company.

While most of the provincially-owned steam railways have been absorbed by C.P.R. and C.N.R., there is the Temiskaming and Northern Ontario line under the control of the Province of Ontario, and the Pacific Great Eastern under the Province of British Columbia. There is one municipal steam railway—the Greater Winnipeg Water District in Manitoba, owned and operated by the City of Winnipeg.

All electric railways that are not under the control of the Board of Transport Commissioners, are under provincial jurisdiction, and many of them are municipally-owned and operated.

HIGHWAYS AND BRIDGES

Highways and bridges, when situated wholly within a province, come under provincial jurisdiction but where they connect two provinces or extend beyond the limits of the province, they become a federal responsibility, under Section 92 (10) of the British North America Act. By the same Act, military roads were placed under Dominion control by authority of Section 91 (7) which states that matters pertaining to "Militia, Military and Naval Service, and Defence" were within the powers of the Government of Canada, and in the Third Schedule mentioned in Section 108, military roads which had formerly belonged to the provinces were transferred to the Dominion.

The Dominion Government is now responsible for:

1. Interprovincial and international highways and bridges. Roads and bridges come under the Engineering Branch of the Department of Public Works but apart from the road work for the Federal District Commission, most of their work has been in connection with bridges.

¹ S.C. 1919 Ch. 11, now R.S.C. 1927 Ch. 3.

2. Military roads—e.g. the Prince Rupert-Terrace-Cedarvale Highway (B.C.) which was started in 1942 and constructed by the Surveys and Engineering Branch of the Department of Mines and Resources, at the request of the Department of National Defence. Roads leading to military airports, either improved directly by the Dominion Government or by the provinces with Dominion assistance would also fall in this group. During the war, this work was carried out by the Department of Transport.

3. Highways and bridges in Yukon and Northwest Territories, in national parks, in Indian Reserves, and on other property belonging to the Dominion Government. Most of this work is carried out by the Surveys and Engineering Branch of the Department of Mines and Resources. Roadwork on civil airports or access to such airports is the responsibility of the Department of Transport.

The Dominion Government has also assisted the provinces with grants-in-aid or conditional grants, under special agreements negotiated between the governments for the construction of mining roads and tourist highways. In some cases in connection with mining roads, the Dominion bore two-thirds of the cost and the province one-third, while during the war, in some cases costs were allocated among Dominion, province and industry. During the depression the provinces were unable to maintain tourist highways and as a means of relieving unemployment the Dominion came to their assistance with grants on a fifty-fifty basis, up to a stated maximum for the Dominion's share. Work had to be in accordance with standards set by the Dominion government aiming at a high quality of construction and the greatest possible benefit to the development of tourist trade.

Under the provisions of the B.N.A. Act construction and maintenance of roads and bridges was made a provincial responsibility. For almost half a century most of this work was entrusted by the provinces to county and municipal authorities which acted as agents for the provinces. Standards varied greatly for the different parts of the country. As highway transportation became more and more important to industrial development and agricultural marketing, provincial governments revived their interest in highways. More scientific methods of road building and the use of heavier labour-saving road machinery necessitated more centralized control. As a result, provincial departments of highways and transportation were organized particularly in the years following the conclusion of the last war. While the allocation of responsibility for roads and bridges between provincial and municipal authorities varies with each province, it is generally true that the provinces are responsible for all main highways and bridges, while purely local roads are under municipal control. The province usually retains the right to take over any part of a municipal road which is required for a main highway. The provinces undertake also the construction of roads of a more local nature that will lead to expanded mining, agricultural or industrial development.

4. HOSPITALS AND OTHER HEALTH FACILITIES

At the time of Confederation, health was not considered a national problem and general health jurisdiction, being regarded as of a local and private nature, was left to the provinces.

Under Section 92 (7) of the British North America Act, "hospitals, asylums, charities and eleemosynary institutions in and for the province, other than marine hospitals" were placed under provincial jurisdiction, while under Section 91 (11) "quarantine and the establishment and maintenance of marine hospitals" are the responsibility of the Dominion Government. Military hospitals are also under federal control by authority of Section 91 (7) which allocates to the legislative authority of the Parliament of Canada all matters pertaining to "Militia, Military and Naval Service, and Defence."

The Dominion Department of Health, as organized in 1919,¹ was charged with the conduct of research, the promotion of public education on health matters and the co-ordination of public health work through co-operation with the provincial authorities, as well as the administration of certain acts, such as the Opium and Narcotic Drug Act.²

Dominion Government activity in the hospital and health fields has developed along the following lines:

(1) The Dominion has constructed hospital and health facilities, and has continued to administer them. Included in this group are:

- (a) veterans' hospitals,
- (b) quarantine stations and immigration medical facilities,
- (c) leper hospitals,
- (d) marine hospitals,
- (e) military and ancillary service hospitals,
- (f) hospitals on Indian Reserves and in the Yukon and Northwest Territories,
- (g) health facilities, including clinics, in areas outside provincial control (e.g., sanitation facilities in national parks.)

(2) The Dominion Government has constructed hospital and health facilities, and has handed over the administration of such facilities to provinces, municipalities or hospital boards, e.g., Veterans' Pavilion at the Ottawa Civic Hospital.

(3) The Dominion Government has made financial contributions to other governments or boards for hospital construction.

- (a) Such grants have been made in cases where the expansion of health facilities in municipalities was considered a national responsibility as in the case of the City of Halifax where it was found necessary to provide special hospital facilities for the substantial population increase, the direct result of war activity in this area;
- (b) Dominion grants were also given on a per-bed basis. Certain conditions such as the establishment of priorities for veterans, were attached to these grants which were made by the Department of Veterans' Affairs to provincial, municipal and private hospitals.

¹ S.C. 1919, ch. 24.

² S.C. 1929, ch. 49 and amendments.

Responsibility for the facilities listed under 1 (a), and 2 and 3 (b) is in the hands of the Department of Veterans' Affairs. Hospital and other health facilities listed under 1 (b), (c) and (d) and 3 (a) are under the jurisdiction of the Department of National Health and Welfare. Hospitals mentioned in 2 (f) are the responsibility of the Department of Mines and Resources; military hospitals in the strict sense of the word are under the Department of National Defence, but hospitals for the use of veterans are under the Department of Veterans' Affairs; health facilities in national parks are the joint responsibility of the Departments of Mines and Resources and National Health and Welfare.

The Dominion Government also makes grants to voluntary organizations engaged in public health work such as the Canadian Institute for the Blind or the Victorian Order of Nurses.

In general the administration of local public health activities and the establishment and maintenance of institutions for such purposes, rests with the provinces. Public hospitals are usually erected and supported by municipalities, while hospital revenue is augmented by grants from provincial governments. Most mental institutions are under provincial administration although in Nova Scotia some are still operated as county institutions. Homes or schools for the deaf and dumb, and the blind, are under provincial supervision. Charitable institutions, such as homes for the aged, are the responsibility of the provinces and are usually operated by cities, counties or municipalities, or religious and benevolent societies under provincial supervision.

Briefly, the provinces are responsible for:

- (a) Public hospitals, including isolation, maternity and children's hospitals, tuberculosis sanatoria.
- (b) Mental hospitals, including homes for the feeble-minded and epileptic.
- (c) Institutions for deaf, dumb and blind.

(d) Charitable institutions, caring for the poor and destitute of all ages.

(e) Itinerant clinics and dispensaries of pediatry and tuberculosis.

5. ESTIMATED EXPENDITURES ON PUBLIC CONSTRUCTION PROJECTS

The division of responsibility between Dominion and provincial (and municipal) governments in the public projects field has had a decided effect on the extent of public investment undertaken by the different levels of government.

Expenditures on public projects in 1930 were estimated at 238.2 million dollars, of which 75.1 million dollars were spent by the Dominion Government, 92.1 million dollars by the provinces, and 71 million dollars by the municipalities and other organized units (see Table 1). While the Dominion contributed about one-third of the total public construction in this year, its contribution declined very substantially in 1937 when it spent only 31.2 million dollars or about 15 per cent of a total of 208.3 million dollars. This shift was mainly due to the fact that the Dominion Government had completed a number of large capital projects by 1930, such as the Welland Canal and the Hudson Bay Railway. During the thirties, no major capital projects were undertaken directly by the Dominion Government. The policy was rather one of assisting financially the provinces' own capital undertakings instead of embarking on a direct Dominion programme.

Expenditures on streets, highways and bridges have played an important part in total outlay on public construction projects. In 1930, for example, almost 120 million dollars were spent for this purpose, representing about half of the total of the public construction projects. The proportion was higher in 1937 when some 145 million dollars were spent for streets, highways and bridges, comprising two-thirds of the total outlay in this year.

TABLE 1.—ESTIMATED EXPENDITURES ON PUBLIC CONSTRUCTION PROJECTS BY DOMINION, PROVINCIAL AND MUNICIPAL GOVERNMENTS, CANADA, 1930 AND 1937

(Thousands of Dollars)

Type of Expenditure	1930			1937		
	Dominion	Provinces	Municipalities	Dominion	Provinces	Municipalities
Streets, highways, etc.....	1,026	69,664	41,393	1,096	108,251	29,922
Bridges, subways, etc.....	2,297	4,568		305	5,036	
Buildings and grounds.....	18,066	12,653	29,607	10,629	7,932	21,392
Watermains, sewers, etc.....	121	34		23	391	
Dams, reservoirs, etc.....	494	195	29,607	460	306	21,392
Electric stations, transmission lines, etc.....	114	528		145	40	
Docks, wharves, piers, etc.....	22,709	105	29,607	8,123	34	21,392
Rivers, canals, dredging, etc.....	13,931	94		5,680	5	
Other engineering construction.....	16,362	4,271		4,701	3,788	
Total.....	75,120	92,112	71,000	31,162	125,783	51,314

SOURCE: Compiled from "Public Investment and Capital Formation, a Study of Public and Private Investment Outlay, Canada, 1926-1941," prepared for the Dominion-Provincial Conference on Reconstruction.

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